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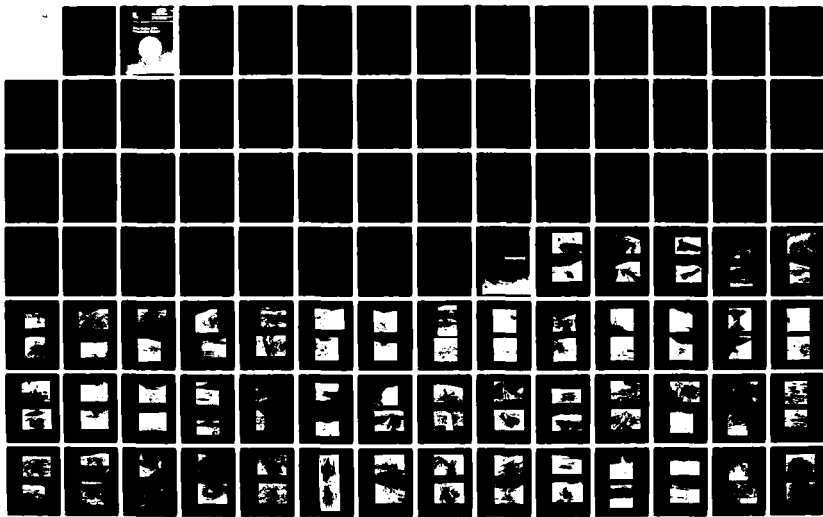
CAVE BUTTES DAM FOUNDATION REPORT GILA RIVER BASIN:
PHOENIX ARIZONA AND VICINITY (INCLUDING NEW RIVER)(U)
ARMY ENGINEER DISTRICT LOS ANGELES CA AUG 83

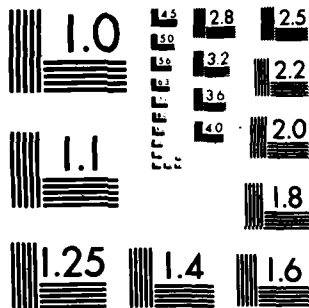
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A summation of the foundation exploration and subsequent foundation treatment and grouting program during construction of Cave Buttes Dam near Phoenix, Arizona. Includes 94 photos and 58 plates.		

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA
MARICOPA COUNTY, ARIZONA

CAVE BUTTES DAM
FOUNDATION REPORT

U.S. ARMY, CORPS OF ENGINEERS
LOS ANGELES DISTRICT
AUGUST 1983



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ATTACHMENTS

1. Final Contract Quantities and Costs
2. Grouting Summary

I. INTRODUCTION

LOCATION

1.01 Cave Buttes Dam is located in Maricopa County, Arizona, approximately 19 miles north of downtown Phoenix. The dam is on Cave Creek about 0.7 miles downstream (south) of the historical Cave Creek Dam. The new dam controls a drainage area of 191 square miles and is a portion of the New River and Phoenix City Streams, Arizona Flood Control Project. Major elements of the project are: the main embankment, outlet works, spillway, three dikes and the bypass channel. The bypass channel forms a spillway within the reservoir to pass water around Cave Creek Dam and prevent the flow of water over the top of the old concrete dam. Plate 1 shows the project location.

PROJECT DESCRIPTION

1.02 Main Embankment. The dam is a rolled earthfill structure, zoned with three classes of material to provide an exterior pervious shell and an impervious core which extends to bedrock. Crest length of the dam is 2,260 feet at elevation 1,679 feet above M.S.L. Maximum height above streambed is 109 feet. At maximum water surface elevation (1,674.1 feet) the total storage is 86,056 acre feet. During a maximum probable flood the peak inflow would be 172,000 cfs, and the peak outflow would be 100,600 cfs. Plate 2 shows the general plan and location of Cave Buttes and appurtenant structures.

1.03 Outlet Works. The outlet works are located on bedrock at the left abutment of the dam. They consist of an approach channel, intake tower, a circular 3.75-foot diameter conduit 528.75 feet long, a reinforced concrete energy dissipator and an unlined channel that discharges into the main stream channel. See Plates 5, 20 and 21.

1.04 Spillway. The spillway is in a natural saddle approximately 1,600 feet northwest of the main embankment. The crest elevation of 1,657.1 feet and width of 510 feet fit the natural terrain. The spillway was excavated in rock and is unlined. The crest is protected from erosion by a 5-foot thick concrete sill 3 feet wide at the bottom and 5.5 feet wide at the crest elevation. The sill extends completely across the spillway crest and continues up each side wall as a 2-foot thick slab to an elevation of 1,670 feet. The detached broad-crested spillway is trapezoidal in cross section with side slopes cut 2 vertical on 1 horizontal. Benches 12 feet wide were cut at elevation 1,680 feet to control erosion of excavated slopes. See Plates 5, 16, 17 and 18.

1.05 Dikes. Three dikes were required to elevation 1,679.1 feet in order to confine the maximum water surface and maintain a 5-foot freeboard.

1.05.01 Dike No. 1 is located in a saddle about 90 feet northwest of the main embankment. At crest elevation (1,679.1 feet) it is approximately 930 feet long. Maximum height is 39 feet. See Plates 5, 11, 12 and 13.

1.05.02 Dike No. 2 is approximately 6,000 feet northeast of the main embankment. The west end of Dike No. 2 abuts on rock and the east end feathers out onto the plain east of Cave Creek Road. At crest elevation it is about 9,035 feet long. Maximum height is 55 feet above the original ground elevation. See Plates 5 and 15.

1.05.03 Dike No. 3 is located about two miles northwest of the dam. The length is approximately 3,245 feet at the crest elevation. The height is a maximum of ten feet above the original ground surface.

1.06 Bypass Channel. The bypass channel is 400 feet wide with invert elevations of 1,628 feet at the channel crest, 1,620 feet at the upstream end and 1,613 feet at the downstream end. Two channels, which drain into the reservoir upstream of the old concrete dam, cross the upstream end of the bypass channel. The downstream end is in a natural channel leading directly into the reservoir of Cave Buttes Dam. The bypass channel is unlined and the crest is not protected from erosion. Erosion of the invert or walls of the bypass could only result in more rapid equalization of water levels on upstream and downstream sides of the old dam. Plates 22 and 23 show the plan, profile, and sections of the bypass channel.

CONSTRUCTION AUTHORIZATION

1.07 The New River and Phoenix City Streams Flood Control Project, also known as the Phoenix, Arizona and Vicinity (including New River) Project, was authorized by the Flood Control Act of 1965 (Public Law 89-298, 89th Congress) which states, in part, under Section 204 that "The project for flood protection at Phoenix, Arizona and vicinity, is hereby authorized substantially, in accordance with the recommendation of the Chief of Engineers In-house Document Numbered 216, Eighty-ninth Congress at an estimated cost of \$58,310,000." Cave Buttes Dam is a part of that project. Final contract quantities and costs are listed in Attachment 1.

PURPOSE AND SCOPE.

1.08 This report assembles information detailing the foundation conditions and materials encountered, and any treatment or adaptations required by them at Cave Buttes Dam and appurtenances. The project was

completed in December 1979. The purpose is to document in a concise foundation report complete geologic records for convenient reference, should an occasion arise at some future date which requires use of these records. Data presented include information from geologic studies and exploration made prior to and during construction, as well as specific details of conditions encountered and construction operations related to foundations. The text, plates and photographs describe the foundation conditions, foundation treatment and construction features of the dam, outlet works, dikes, spillway and bypass channel. Complete engineering characteristics of overburden materials, conditions of foundations composed of overburden materials, data on excavation and placement of embankment materials and instrumentation are presented in Phase II, Part 1 of the General Design Memorandum (GDM), Cave Buttes Dam dated July 1976. Other pertinent data concerning the project can be found in Design Memorandum No. 3, Cave Buttes Dam, Phase II, July, 1976.

CONTRACTORS AND CONTRACT SUPERVISION

1.09 The project was constructed by Washington Construction Co., P.O. Box 8989 Missoula, Montana, under government contract No. DACW-77-C-0058. The total amount of the bid for construction was \$9,769,353. The work started in September 1977 and was completed in December 1979. Contract Supervision was by the U.S. Army Engineer District, Los Angeles. Veryl Cox was Project Engineer and Filmore Turner was Project Geologist.

II. FOUNDATION EXPLORATION

INVESTIGATIONS PRIOR TO CONSTRUCTION

2.01 General. Subsurface investigations were made at Cave Buttes Dam in the foundation areas of the dam, dikes, outlet works, spillway and the bypass channel. The subsurface investigations were started in March 1970 and were completed in October 1975. Field exploration consisted of site reconnaissance, deep and shallow seismic refraction surveys, diamond core drilling, bucket-type power auger drilling, and excavating trenches with a dozer and Gradall. Soils exploration data and results of tests on soils from trenches and bucket auger holes are presented in the GDM. General plan of geologic exploration is indicated on Plate 3. General site geology, plan of geologic exploration, and geologic sections are shown on Plates 4 and 5.

2.02 Embankment Foundation. Subsurface exploration in the streambed consisted of drilling 6 diamond core holes to depths ranging from 60 to 100.6 feet and excavating 4 test trenches (TT 70-20 through 22 and 36) to depths ranging from 16 to 32 feet. The materials encountered during the diamond drilling and the results of the water pressure tests are described in the logs of the holes. Plate 6 shows logs of holes D-4u, D-6u and D-20u. Logs of D-5u, D-15u and D-16u are on Plate 7. Location of each hole is shown on Plate 3. Test trench locations and results of the moisture content and in-place density tests and the classification of the material are presented in the GDM. Plans, profile and sections of the main embankment are shown on Plates 11, 12, 13, and 14. Both deep and shallow seismic refractive surveys gave information on seismic velocities in the embankment foundation. Location of seismic lines are shown on Plate 8. Sections and Time-Distance graphs are shown on Plate 9.

2.03 Dam Abutments. Four diamond core holes penetrated the abutments: D-3u and D-19u on the right abutment to depths of 75 and 101.3 feet, respectively, and D-7u and D-26u to depths of 75 and 30 feet, respectively, on the left abutment. Investigation on the left abutment along the alignment of the outlet conduit is discussed in paragraph 2.07. See Plate 3 for locations and Plates 6 and 7 for logs of the diamond core holes.

2.04 Dike No. 1. Diamond core holes D-9u and D-10u were each drilled 25 feet to investigate subsurface conditions at Dike No. 1. Test trench 70-38 was excavated to a depth of four feet. A log of the trench indicated an average of one foot of overburden covering bedrock consisting of red, gray and green schist which was hard at a depth of three feet. Logs of the holes are on Plate 6. Plates 11, 12 and 13 show the plan, profile and sections of Dike No. 1. Log and location of TT-70-30 is presented in the GDM. Shallow seismic refractive surveys gave information on seismic velocities in the dike foundation. Location of seismic lines are shown on Plate 8. Sections and Time-Distance graphs are shown on Plate 10.

2.05 Dike No. 2. Two diamond core holes were drilled at Dike No. 2. Hole D-11u in the right abutment penetrated 51.2 feet, encountering 4.6 feet of older alluvium overlying greenschist. Hole D-12u, approximately 900 feet east along the dike axis and at an elevation 32 feet lower than D-12u, encountered both Recent and older alluvium without reaching bedrock when the hole was completed at a depth of 60 feet. Additional investigation was done

by bucket auger holes, undisturbed samples and various soils investigation tests, giving results presented in the GDM. Shallow seismic refractive surveys gave information on seismic velocities in the dike foundation. Location of seismic lines are shown on Plate 8. Sections and Time-Distance graphs are shown on Plate 10.

2.06 Dike No. 3. The dike foundation was investigated by bucket auger holes. An analysis of the data secured is discussed in the GDM. Shallow seismic refractive surveys gave information on seismic velocities in the dike foundation. Location of seismic lines are shown on Plate 8. Sections and Time-Distance graphs are shown on Plate 10.

2.07 Outlet Works. Foundation investigation for the outlet works also provided additional information on the left abutment of the main embankment. Five diamond core holes were drilled, ranging in depth from 40 to 100.3 feet, and three test trenches were excavated. Test trench 75-1, 75-2 and 75-19 at depths of 19.5, 27.5 and 27.0, respectively, each exposed bedrock at points along the centerline of the outlet. Logs of holes D-8u and D-21u are on Plate 6 and logs of holes D-17u, D-18u, D-27u, as well as of TT-75-1, TT-75-2 and TT-75-19 are on Plate 7. Location of all outlet works exploration is shown on Plate 3.

2.08 Spillway. The investigation for the spillway, located approximately 1,600 feet northwest from the dam site, included drilling six diamond core holes ranging in depth from 25.2 to 60.3 feet and excavating one test trench, TT-70-25, to a depth of 25 feet. A Caterpillar D-8 dozer with hydraulic blade and rippers was used to excavate the trench and to determine the rippability, breakdown properties of the rock, and possible size gradation of the excavated

material. Locations of the holes are shown on Plate 3. Logs of holes D-1u and D-2u are shown on Plate 6, and logs of holes D-22u, 23u, 24u and 25u are shown on Plate 7. Four shallow seismic probes provide a section along the spillway crest with information on seismic velocities. Location of seismic probes are shown on Plate 8. Sections and Time-Distance graphs are shown on Plate 10.

2.09 Bypass Channel. Investigation for the bypass channel consisted of geologic inspection, mapping and a seismic refractive survey. Results are shown on Plate 22. Plate 23 shows the bypass channel plan, profile and sections.

2.10 Riprap Investigation. Potential locations which could supply facing stone were evaluated to identify possible economical sources of riprap. Stockpiles of cobbles and boulders at commercial plants processing alluvium were also inspected. Processing of alluvium from the pervious borrow areas was considered. An exposure of bedrock approximately one mile southwest of the dam site was explored by drilling six diamond core holes ranging in depth from 37.5 to 101.1 feet. Locations of holes (D-28u through D-33u) are shown on Plate 4. The Contractor selected not to open a quarry or process material from the pervious borrow areas as he could supply cobbles for facing stone from stockpiles at the United Metro Plant located downstream from Cave Buttes Dam.

2.11 Refractive Seismic Surveys. Seismic surveys were conducted during March and April 1970 to determine seismic velocities of subsurface material. The March 1970 survey utilized two lines, each approximately 900 feet long, located along the dam axis in the stream bottom. The measured velocities showed a distinct zoning of materials in the alluvium. From the ground

surface to a depth of approximately 35 feet, the seismic velocities ranged from 4,000 to 10,000 feet per second and from 35 to 150 feet, the velocities ranged from 10,000 to 16,700 feet per second.

2.12 In April 1970, shallow seismic surveys were conducted between test holes where additional information was required. Ten seismic lines were run across the streambed obtaining velocities of the various types of sediments to a maximum depth of approximately 35 feet and the velocity at the alluvium-bedrock contact. The velocities in the streambed alluvium ranged from 1,000 to 5,300 feet per second. The velocity in the rock ranged from 8,000 to 14,000 feet per second with an anomaly of 20,000 feet per second indicated in some runs. Four seismic lines were run along the spillway crest. The velocity in the bedrock from ground surface to 10 feet, varied from 3,900 to 5,000 feet per second and below 10 feet the velocities ranged from 6,600 to 14,000 feet per second.

2.13 Four seismic lines were run along the alignment of Dike No. 1. The material from ground surface to approximately 10 feet have seismic velocities varying from 1,600 to 3,500 feet per second; from 10 to 20 feet deep, the velocities increased to 5,500 feet per second and below 20 feet the velocities increased to 12,000 feet per second. Eight seismic lines were run along the alignment of Dike No. 2. The seismic profile shows quite a large reduction in velocities at locations away from the right abutment and a consistent increase in velocity with increased depth into the flood plain. Near the toe of the right abutment, from ground surface to 7 feet, the velocities varied from 800 to 1,000 feet per second; from 7 to 16 feet, the velocities ranged from 2,700 to 5,100 feet per second; and from 16 to 45 feet, the velocities ranged from

10,000 to 14,000 feet per second, reflecting bedrock at that depth. In the flood plain, the seismic velocities varied erratically from 1,500 to 12,000 feet per second. Below the surficial layer to a maximum depth of 15 feet, the velocities ranged from 1,800 to 3,100 feet per second. A third layer showed velocities from 5,500 to 6,500 feet per second. The higher velocities probably reflect highly consolidated alluvium.

2.14 Five seismic probes were taken along Dike No. 3 at depths of 30 feet. From the ground surface to a maximum of 15 feet the velocities varied from 1,000 to 1,500 feet per second. Below this layer, the velocities varied from 2,900 to 4,700 feet per second. For the seismic line locations and Time-Distance graphs and sections, see Plates 8, 9 and 10.

INVESTIGATIONS DURING CONSTRUCTION

2.15 General. Investigations made during construction included three NX size holes drilled to check distribution of grout take. These holes were located at Sta. 13+27.6 in the right abutment, Sta. 23+13.1 in the cutoff trench and Sta. 30+18.3 in the left abutment. The drilling indicated that the rock was tight and no cavities or voids existed. Although not treated as part of the formal investigation, all dental excavations were checked to determine the adequacy of the rock as a foundation and to insure that any unsatisfactory conditions were corrected. A Gradall backhoe was used during stripping and scaling to investigate and remove apparently unsuitable material. Near Sta. 50+00 of the outlet works, material up to 15 feet below the proposed foundation grade was removed and replaced with concrete to provide suitable foundation.

III. GEOLOGY

REGIONAL GEOLOGY

3.01 The rock types encountered in the mountainous areas of the surrounding region are very similar. The basement complex is composed predominately of Precambrian schistose and massive metaigneous rocks with lesser amounts of associated gneiss and quartzite. These are covered and intruded by Tertiary igneous rocks. The igneous rocks consist of granite, rhyolite, andesite, vesicular basalt flows, tuff and tuffaceous agglomerate. The trend of foliation in the rock formations is in a southwest-northeast direction, and is generally steeply dipping. Alluvium fills the valleys and covers the slopes of the hills and mountains. Older alluvium, which consists of moderately to well consolidated residual soil and talus debris, is generally found along the side slopes of the valleys and underlies the Recent alluvium. In the valleys, the older alluvium is mostly sand and silty sand containing varying amounts of caliche. Recent alluvium, which consists of unconsolidated silt, sand, gravel, cobbles and boulders, is found in the valley areas in the stream channels and the flood plain washes. Rocks similar to those of the nearby hills and mountains probably underlie the alluvial deposits. The deep dissection of the mountains, and the great extent and depth of the alluvial fans suggest that the Phoenix area has undergone a long, stable geologic history.

SITE GEOLOGY

3.02 General. Cave Buttes Dam is located approximately 19 miles north of Phoenix, Arizona and about 0.7 miles south of the existing Cave Creek concrete multiple-arch dam. The dam at streambed elevation (1,570 feet) spans Cave Creek between two rock ridges that parallel the valley. A thin veneer of older alluvium (talus material) covers the upper slopes of the ridges and becomes much thicker on the east side of the valley near the base of the slope. The materials in the valley are Recent and older alluvium, which consists of various combinations of sand, gravel, cobbles and some boulders extending to a depth of approximately 35 feet. Bedrock forming the ridges and underlying the stream bottom is a metaigneous rock, consisting of moderately hard green schist, greenstone and granite. There is evidence of ancient folding and some faulting in the rock formations in the vicinity of the proposed Cave Buttes Dam. Site geology is shown on Plate 4.

3.03 Physiography. Cave Creek rises in the New River Mountains and flows generally southwest through Paradise Valley as an intermittent stream for about 48 miles and through Phoenix to the Salt River; its drainage area at the Salt River is 311 square miles. The gradient in the vicinity of the existing Cave Creek Dam is 50 feet per mile. The portion of the river below the Arizona Canal flows along poorly defined water courses. Cave Creek, at the dam, is an ephemeral stream on alluvial fill with a course which passes through gently sloping desert terrain with low hills rising about 500 feet above the surrounding alluvial slope of Paradise Valley. The dam is located within a cluster of these hills as shown on Plates and 2 and 4.

3.04 Overburden Materials. Except for the residual soil and mantle rock of the upper portions of the hills, overburden consists of Recent and older alluvium.

3.04.01 Recent alluvium, the youngest unit, is material currently being deposited in active stream channels and within the reservoir behind the historical Cave Creek Dam. This material was deposited or has been reworked by floods and lesser flows recently enough to be clearly distinguishable from the older unit. Grain sizes represented in Recent alluvial deposits range from clay through silt, sand, cobbles and boulders. Small amounts of clay binder occur in the stream channel deposits, especially close to bedrock. Reservoir deposits are rich in silt and clay as shown by the plastic nature of material behind Cave Creek Dam. Recent alluvium is directly over bedrock at some locations and lies on older alluvium where bedrock is more deeply buried. Plate 4 indicates the general distribution of deposits of Recent alluvium.

3.04.02 Older alluvium consists of valley fill deposits, talus debris, slope wash and residual materials which have not been reworked by the present drainage system. Silty sand, some clay, angular gravel, sandy gravel and cobbles form this deposit. Most rock fragments are 6 inches in diameter or less, consisting of angular or subangular greenstone or other basement complex rock. Well-cemented material and loosely consolidated portions are both present in the unit. Older alluvium is found on slopes of the hills at the site and underlies the Recent alluvium of the deeply filled valleys. Plate 4 indicates the general distribution of surface exposures of older alluvium.

3.05 Bedrock. Bedrock types encountered in the vicinity of Cave Buttes Dam consists of younger bedrock, older granite and the basement complex.

3.05.01 Younger bedrock types are not common in the project area. Basalt forms a cap on several hills south of the dam. Tuffaceous agglomerate, consisting of greenstone fragments cemented in a tuffaceous matrix, occurs as a veneer at a few locations. Younger granite is locally prominent, generally as irregular intrusions, dikes and lenses or pods a few feet to a few tens of feet in maximum diameter. Alinement of the intrusions parallel with structural elements of the older rock is most common. Only a few small dikes of other intrusive rocks were seen.

3.05.02 Older granite, believed to be Precambrian, is exposed a mile or less west of the dam, and extends westward as a mass with dimensions of several thousand feet.

3.03.03 The basement complex of Precambrian schistose and massive metaigneous rock is the principal bedrock of the project area. Greenstone is the term commonly applied. It is moderately hard to hard, light to dark green, and fine to medium grained. Fracturing occurs mostly along older recemented fractures. Schistose intervals are light to brownish green, moderately hard to soft, platy and chloritic. There are occasional zones of talc and clay. Serpentinization was observed at several locations. Alteration producing iron oxides gives some areas of greenstone a brilliant red or yellow coloration due to the presence of limonite and related minerals.

3.06 Bedrock Weathering or Alteration. Occasional intervals of soft schist occur in the greenstone, especially near granite intrusions. Some of the schist is talc-like in character as on the west (right) side of the spillway. Lenses of granite on the right abutment of the dam were weathered to a yellow rust color. The greenstone near the granite was altered to a red color. Throughout the foundation of the dam, alteration producing limonite and associated iron oxides is common, resulting in greenstone which is red or sometimes rusty yellow. Occasional development of serpentine is seen at various locations. Some of the varieties of altered greenstone are soft and punky. Some locations required dental excavation and replacement with concrete. See Plates 25 through 56.

3.07 Leaching or Solution Activity. No evidence of leaching or solution activity resulting in the formation of voids was found throughout the investigation and construction of Cave Buttes Dam and appurtenant structures.

GEOLOGIC STRUCTURE

3.08 General. Very complex detail was seen in the strip of bedrock cleaned by compressed air to allow careful inspection of the foundation for the impervious core of the dam. Fractures, shears, alteration zones, metamorphism and igneous intrusions are marks left by the forces applied throughout the long existence of the material which is now greenstone of the Precambrian complex. See Plates 25 through 45 for detailed mapping of the foundation for the dam embankment, Dike No. 1 and Dike No. 2.

3.09 Distinctive shear zones. Three shear zones, or faults, cross the foundation area. At Sta. 14+70 a zone of sheared and brecciated greenstone 8 to 11 feet thick forms a band of platy and blocky material with associated gouge. The zone, which is shown on Plate 27, is nearly vertical and crosses almost directly northward. Near Sta. 20+00 a shear zone 26 feet wide at the south edge of the cutoff trench and 3 feet wide at the north edge was present. See Plate 31. Platy and blocky material with gouge forms this zone. The east side of the zone crosses the cutoff trench almost directly northward. Dips range from 40 to 60° eastward. The west side goes northward about 30 feet and then tapers to the northeast until it is only 3 feet from the east side of the shear zone at the north edge of the cutoff trench. Dips measured on the west side and central part were from 80°E, through vertical to 80°W, 70°SE and 40°E. Near Sta. 28+80 the third shear zone extends northward across the foundation. This zone is 10 feet wide on the south edge of the strip and 3 feet wide on the north edge. Sheared greenstone and gouge are dominant. See Plate 36.

3.10 Complexity of Structure. The complex combination of a large shear zone, thrust faults, thinner shears and igneous intrusions shown on Plate 35 near Sta. 27+30 helps in understanding some of the complex detail throughout the foundation. The large shear zone is 18 feet wide on the south edge of the cleaned area and it extends to 40 feet northward. At that point the shear is 10 feet wide. The shear zone splays out into about seven branches. The branches are thrust faults and have associated shear zones less than a foot wide. Several granite dikes are present in the area. One dike is one foot wide and extends 42 feet to the northeast. A semicircular thrust fault exposure shows dips of 40°, 30°, and 40° directly toward the dike, suggesting

the thrust fault is in the shape of a plunging syncline with the dike along its axis. Granite dikes, lenses or pods occur at various places along the foundation, such as Sta. 9+80 (Plate 25) and 13+00 (Plate 26) where lenses trend N30°, nearly parallel with much of the jointing. Other occurrences of granite are scattered sparsely throughout the foundation area. All of the granite in the dam foundation is referred to as the "younger granite" in contrast to the Precambrian granite just west of the project area. No specific age dates are available, and mode of occurrence is the basis for separating the two types of granite. The very complex detail of shearing and jointing shown on the foundation geology plates 25 through 45 may be related to forces associated with emplacement of the younger granite.

3.11 Structural trends.

3.11.01 Dam. The general structural trend of the rock of the right abutment (Sta. 9+80 to 13+50 shown on Plates 25 and 26) is northeast. More than fifty granite dikes, lenses or pods fit into this pattern. Cross joints are common but are less persistent than the joints with a northeast strike. The dip of the joints is variable in both direction and strike, resulting in a bedrock which is platy to blocky in character. The trend changes to due north at Sta. 13+40, where two shears less than a foot thick extend northward across the foundation with minor warping and branching. East of the shear zone at Sta. 14+70, described earlier, the northward trend is less distinct. The trend is replaced by a series of warped, branching and intersecting shears less than a foot thick which trend northeast and northwest in a complex manner while maintaining a general northward trend. Dips are mostly between 90° and 50°. At Sta. 22+00, complexities increase and include shear zones less than a

foot thick which curve, branch, rejoin and have short sections which become thrust faults. This trend ends at the shear zone near Sta. 28+80, which was described earlier. The left abutment eastward from the outlet conduit is characterized by shears less than one foot thick which branch and curve but maintain a general northwest trend. A northeast trend is superimposed east of Sta. 31+00. See Plates 25 through 38.

3.11.02 Dike No. 1. This dike starts less than 100 feet due east of the main dam, where it extends east a short distance before curving to the northeast. The foundation is primarily fractured and sheared greenstone. Three shear zones thicker than 3 feet cross the foundation of the dike. At Sta. 33+65 a shear zone with 3 to 5 feet of gouge shows a strike of $N5^{\circ}W$ and dip of $45^{\circ}W$. At Sta. 37+40 a shear zone 10 to 25 feet wide was mapped. A strike of $N80^{\circ}W$ and dip of $40^{\circ}S$ was observed. At Sta. 38+65 a shear zone 3 to 5 feet wide had a strike of $N15^{\circ}E$ and dip of $70^{\circ}E$. Thinner shears with gouge and joints are present throughout the cleaned strip. The shears intersect, branch, rejoin, splay out and show wide variation in dip and strike. See Plates 39 through 43.

3.11.03 Dike No. 2. This dike is located about 6,000 feet northeast of the dam embankment. The basic foundation of the right abutment, Sta. 50+09 to Sta. 53+55 is sheared and jointed greenstone, however, a veneer of tuffaceous agglomerate is present where it was not removed by abutment excavation. The foundation northeast of Sta. 53+35 is older alluvium and is further described in the GDM. Two shear zones are persistent and thick enough to be described. The first, at Sta. 50+60, trends $N48^{\circ}E$, dipping $80-85^{\circ}$

southeast, and the second, at Sta. 51+40, is 2 to 3 feet wide and was traced across the foundation. The strike is N58°E and the dip is 60° southeast. Dips of fractures range from 85 to 25°. See Plates 44 and 45.

3.11.04 Dike No. 3. This dike is located about 2 miles northwest from the main embankment. Alluvial slopes forming the divide between New River drainage area and Apache Wash, tributary to Cave Creek Dam, form the foundation of Dike No. 3. The foundation materials consist of surficial layers of sandy clay over-lying a highly cemented sandy silt or clayey sand. (Exploration and conditions at Dike No. 3 are considered in the GDM).

3.12 Ground Water. The headwaters of Cave Creek are located above the town of Cave Creek. The creek crosses six miles of alluvial plain before it bends northeast at a point one mile north of Cave Buttes Dam. The plain slopes 25 miles southeast to the Salt River and comprises Paradise Valley. A well penetrated 1,136 feet of alluvial valley fill near the center of the six mile reach of Cave Creek. The deep alluvium of Paradise Valley continues to the Salt River, past the city of Scottsdale. Any water absorbed by the alluvium crossed by Cave Creek in upper Paradise Valley would continue as groundwater recharge of the valley. Surplus water during periods of substantial flow would travel down Cave Creek and be controlled by Cave Buttes Dam. Ground water in the vicinity of the dam was at elevation 1,538 feet prior to construction. This represented a local water table maintained by only about 35 feet of alluvium over the bedrock and extensive ponds from local gravel operations which were filled during times of heavy rainfall. During excavation for the cutoff trench, seepage occurred along the sides of the cutoff trench where the contact of the rock and alluvium was at lower elevations. After the heavy March 1978 rains, considerable seepage, about 300

gallons per minute, occurred along the rock on both sides of the cutoff trench throughout much of its length, due to the ponding of water in the gravel pits. By July 1978, the ponds had dried up and only a slight seepage was occurring. Seepage through rock continued along the base of the left abutment and near Stas. 14+00 and 27+00 near the base of the right abutment in areas of close jointing and complex shear zones. These seeps were sealed by grouting.

IV. DIVERSION AND CONTROL OF WATER

4.01 The control of surface flows and shallow ground water during the rainy season was a problem to the contractor in his operations in both the construction site for the dam embankment and the upstream impervious borrow area. The historical Cave Creek Dam was very beneficial to the contractor in the control of water during the two major flood periods that occurred in February-March 1978. Through the close control of floodwaters by the combined efforts of the Maricopa County Flood Control District, the Corps of Engineers personnel and the contractor's men and equipment, a great amount of damage was avoided when flow was curtailed by controlled release of water through the outlet works of the existing Cave Creek Dam. The Contractor's dewatering plan consisted of constructing a diversion levee and channel from the outlet of Cave Creek Dam extending along the base of the right (west) abutment through the construction site to control surface flow. The excess flow was discharged downstream from the dam site into the natural drainage channels of Cave Creek. The levee and channel were kept in good operating condition until the embankment was high enough to divert runoff through the new outlet works. A considerable amount of maintenance of the levee was required to contain the high discharge in the channel during the periods of high run off when erosion was taking place along the levee.

4.02 While the alluvial materials in the streambed were being excavated to bedrock and during grouting and treatment of the foundation rock, the contractor had to control the water flowing in along the bedrock contact and the seepage from surface fractures in the rock. The source of the water was from gravel pit ponds both upstream and downstream of the excavation. The Contractor excavated a small trench in the rock along the upstream and downstream toe of the cutoff excavation to collect water seeping into the construction area. The water was collected in sumps and pumped to discharge downstream of the excavation and into the diversion channel. At the time the core material was placed, seeps from the fractured rock had been grouted off and the minor amount of seepage along the upstream and downstream toe was controlled by sump pumps so that placement of the core material on the rock surface was accomplished with a dry foundation. See Photos 1 through 12.

V. FOUNDATION PREPARATION

5.01 General. The preparation of the foundation included stripping the overburden material and removing loose rock from the abutments of the dam and of Dikes No. 1 and 2. The preparation also included the stripping of the alluvial materials under the outer zones of the dam embankment in the streambed to elevation 1,558 feet and the excavation of the cutoff trench to bedrock. After excavation of the overburden or alluvium, the bedrock was cleaned several times by air blasting along with a considerable amount of handwork to remove all loose rock within the area of the core trench and 12 feet upstream and downstream of the core contact.

5.02 Stripping and Scaling. After removal of the overburden, approximately 1 to 2 feet of material was excavated from both abutments of the dam and from the streambed using a D-9 dozer followed by a rubber-tired backhoe. Approximately 6 inches to 1 foot of residual soil and weathered bedrock were removed from the abutments and foundation of Dike No. 1 and the right abutment of Dike No. 2. The bedrock surfaces were first cleaned with high pressure air and handwork by laborers prior to geologic mapping and grouting. Scaling was not required on the left abutment of the main embankment or for Dikes Nos. 1 and 2. The lower portion of the right abutment for the main embankment from elevation 1,584 to 1,558 feet, was scaled to the following slopes: from centerline to 10 feet downstream of centerline, the slope was cut 1V on 1H; from 10 to 95 feet downstream of centerline, the slope was cut on a 1.25V on 1H and from 95 feet to 168 feet downstream of centerline, the slope was cut of 1.5V on 1H. The scaling was accomplished by drilling on 2-1/2 foot centers and blasting with 40 percent gelatin. After the scaling, there remained no near-vertical faces greater than 3 feet high. See Photo 13.

5.03 Excavation.

5.03.01 Dam, Right Abutment. The right abutment consisted of a reddish brown highly fractured schistose greenstone with occasional dikes of highly weathered light colored granite. After removal of 6 to 8 inches of residual soil, the foundation area for the core zone was cleaned with air and prepared for grouting. The combination of fracturing and weathering left a somewhat irregular foundation surface, with local relief varying from 6 to 12 inches. Although some higher slopes in the rock surfaces were present,

usually along infrequent shear zones, a minimal amount of excavation was necessary. After the overburden was removed to suitable bedrock, the surface was cleaned with high pressure air to prepare the surface for grouting. See Photos 14 through 18 for views of material exposed by the right abutment excavation.

5.03.02 Dam, Left Abutment. The left abutment consisted of highly fractured schistose greenstone with a few small dikes of intrusive rocks. Remnants of Tertiary volcanic breccia were plastered on portions of the greenstone bedrock. This material was removed by hand labor using picks and jack hammers or treated with mortar or dental concrete as necessary before any fill material was placed. The materials removed from the abutments to elevation 1,558 feet were classified as abutment excavation. Again the bedrock surface was cleaned with high pressure air to prepare the surface for grouting. See Photos 19 through 25 for views of material exposed by the left abutment excavation.

5.03.03 Cutoff Trench. The material excavated below elevation 1,558 feet was classified as cutoff trench excavation. The cutoff excavation consisted of excavating alluvial streambed material. Suitable excavation materials were placed in zone III, the pervious zone of the embankment. The bedrock surface exposed by the excavation was an undulating surface, with some areas having 2 to 4 feet of soft weathered material. The bedrock consisted of highly fractured blocky schistose greenstone with a few small intrusive dikes. These materials are very similar to the abutments but are highly sheared and brecciated. Most of the jointing and foliation trends in a north to northeast direction. Heavy equipment used in the excavation of the cutoff

trench and the weathered condition of the bedrock resulted in some over-excavation resulting in a relatively uneven surface. In depressions where densification by rolling of core material was not possible, the areas were filled with dental concrete. Heavy rains that occurred during and after the excavation of the cutoff trench caused ponding of water in the excavation. Water from ponding and local seepage was removed by sumping and pumping until the foundation could be cleaned by blowing off all the loose material with high pressure air and removing the loose material with rubber-tired front end loaders. This operation was required more than once in some areas when after cleaning, the area became wet again or was submerged for several days. Repeated cleaning was necessary to prepare the surface for grouting. One high rock knob, at Sta. 28+25, was drilled and blasted. This was the only drilling and blasting required in the cutoff trench. See Photos 26 through 28 for views of foundation rock exposed in the cutoff trench.

5.04 Outlet Works. The excavation of the outlet works near the toe of the left abutment and dam Sta. 29+25 commenced after the core and transition zones were stripped of overburden to streambed elevation 1,558 feet. See Photos 29 through 40.

5.04.01 Intake Tower. The intake structure and retaining wall are located at Sta. 53+92 on the upstream portion of the outlet works. The east side of the retaining wall was notched into the bedrock. The notch was excavated by controlled drilling and blasting, however, because of the joint pattern of the rock, there was a slight overbreak. After the retaining wall was constructed, the space between the rock and conduit was backfilled with selected silty sand and compacted by hand held power tampers. See Photos 30 and 31.

5.04.02 Outlet Conduit. The outlet structure was constructed on fractured greenstone from Sta. 53+92 to 50+85. During the excavation from Sta. 50+85 to 48+10, alluvium and highly weathered and sheared greenstone were encountered which had been eroded deeper than the invert for the structure. These materials were overexcavated to remove compressible material from the base of the outlet conduit structure. The area overexcavated was approximately 275 feet long with a maximum depth of overexcavation of approximately 15 feet. The area overexcavated was cleaned and backfilled with concrete to form an incompressible and impervious foundation for the outlet works conduit. At Sta. 47+41, a cutoff for the energy dissipator was line drilled to 3 feet, trimmed with air hammers and backfilled with concrete. A section of the outlet works east wall, between Sta. 50+50 and 52+00 was line drilled on 12 inch centers to 8 foot depths; every other hole was loaded with 40 percent gelatin. The results of the blasting provided a relatively smooth sound wall. See Photos 29 through 40. A D-9 dozer and Gradall was used for removal of material in the excavation for the outlet conduit. See Plates 19 through 21 and 46 through 49.

5.05 Dike No. 1. After removing the top few feet of soil, the exposed bedrock consisted of highly fractured reddish brown to a drab green schistose greenstone. No scaling was necessary to flatten the slopes before any surface treatment was done. After the soil and approximately 2 feet of weathered bedrock was removed, the surface was blown off with high pressure air to prepare the surface for grouting. See Photos 41 through 44.

5.06 Dike No. 2. After removing the top few feet of soil and weathered bedrock on the right abutment, the exposed bedrock was highly fractured and was similar to that of Dike No. 1. No further excavation was required. The surface was blown off with high pressure air to prepare the surface for grouting. See Photos 45 and 46.

5.07 Spillway. The spillway was excavated through steeply dipping thinly bedded schist, blocky greenstone and occasional hard lenses of quartzite. The material excavated was not suitable for fill in the embankment and it was wasted. The excavated materials were placed upstream of the spillway, extending the approach apron. Most of the foliated bedrock trended about 30° northeast with dips between $70-90^{\circ}$ to the north. The right (west) wall of spillway between Sta. 19+70 and 22+50 started slaking soon after exposure to the air and was cut back on a somewhat flatter slope. The excavation of the left (east) wall stood up well at a 2V on 1H slope. A relatively trapazoidal, 510 foot long trench at least 5 feet wide on top and approximately 3 feet wide at the base by approximately 5 feet deep was excavated for construction of the sill across the spillway crest at Sta. 18+00. The excavation of the trench was accomplished by line drilling with holes on 1-foot centers along the centerline of the sill. Every other hole was loaded with 2 to 1-1/2 inch by 3 inch long sections of 40 percent gelatin, with stemming material separating these sections. After shooting, the broken rock was removed with a backhoe and trimmed with air hammers. The excavation for the sill provided a satisfactory surface for placing concrete. The sill controls erosion of the spillway invert and sides. The notch on the right (west) wall was excavated with a Gradall for the right sill wall. The much harder rock on the left wall had to be drilled and blasted. The cut did not break out well because of the

complex joint pattern. The excavation was formed and backfilled with concrete. The sides of the sill were constructed to a 13-foot height. See Photos 47 through 56. See Plates 16, 17, 18 and 50 through 56.

5.08 Bypass Spillway Channel. The excavation of the bypass spillway channel was routinely accomplished using a heavy duty dozer and a rubber tired backhoe. Occasional blasting was required. See Photos 57 and 58 and Plates 22 and 23.

VI. FOUNDATION TREATMENT

EMBANKMENT

6.01 General. After each segment of the foundation of the dam was excavated, the bedrock surface within zone 1 and an additional 12 feet upstream and downstream of zone 1 was cleaned of loose material using high pressure air hoses. Geologic features of the bedrock surface were then mapped, and a concurrent foundation drilling and grouting program started. The specified grouting program, which consisted of a 40-foot spacing of holes, was fundamentally a foundation proofing program or an extension of the design investigation to assure that no pervious zones or voids crossed the foundation. In general, foundation conditions that were exposed and as drilled for grouting were essentially as anticipated during design. All excavations inspected showed rock of adequate quality and competence for the foundation of a dam of the size and purpose of Cave Buttes Dam. The grouting commenced 23 January and was completed 15 August 1978. There was a delay of nearly a month due to a period of high rainfall. A total of 222 grout holes were drilled and grouted near the center of the core zone, forming a single

line curtain with numerous additional grout holes drilled off the line. The holes ranged in depth from 8 to 75 feet, and were EX size with the exception of 3 NX size exploratory grout holes. See Plates 57 and 58.

6.02 Right Abutment. The foundation treatment on the right abutment between Stas. 10+00 and 13+50 consisted of drilling and grouting 13 EX holes and a NX exploratory hole for a total of 507 feet. Eleven holes were drilled on 40 foot centers along the centerline of zone I core material, with hole No. 53 bracketed about 10 feet on each side because of the amount of grout used. Total grout take in hole No. 53 was 4-3/4 sacks of cement at mixtures of 3:1 and 2:1 at a pressure of 10 psi. The average grout take for all holes in the right abutment was 0.06 sacks per linear foot of hole. The rock within the core zone was then mapped, see Plates 25, 26, 57 and 58. All loose rock material, grasses and roots that had accumulated since the grouting were removed. Shear zones and open joints were treated with a sand-cement mortar mixture. Overhangs were removed and larger depressions were filled with dental concrete. The core zone of the right abutment above elevation 1,558 feet was closely inspected, mapped and photographed at each five foot increment, before and after foundation treatment. No embankment material was placed before each increment was approved for adequacy of treatment by the project geologist. When required, the abutment was again air cleaned prior to placing embankment material. See Photos 59 through 62.

6.03 Cutoff Trench (core trench). The foundation treatment of the cutoff trench between Sta. 13+50 and 29+00 consisted of drilling and grouting 150 EX holes and one NX exploratory grout hole; a total of 5,905 feet of drilling. Of this drilling, 106 holes were drilled along the centerline of zone I, core material. The line of grout curved downstream approaching the abutments.

Distance from the centerline of the dam was approximately 42 feet across the mid-portion of the valley. Forty-five additional holes were drilled to insure sealing of potential problem areas where surface fractures were more frequent, especially in the vicinity of fault gouge, breccia and surface seeps. Where required, the spacing of the grout holes within the cutoff trench was reduced to 20 foot centers after pressure tests on some of the holes indicated an anomalous water versus grout take. There were no significant changes in grout take and it was, therefore, concluded that the foundation was tight. The average grout take for all holes in the cutoff trench was 0.05 sacks per foot of hole. After the grouting was completed the area was mapped, see Plates 27 through 35, 57 and 58. The area was again cleaned by blowing off the loose earth and rock with air. Larger depressions, where the densification of the core material with rubber tired rollers was not possible, were filled with dental concrete. Smaller areas and open joints were filled with mortar. This treatment consists of filling small depressions or surface irregularities to prevent seepage between the rock formation and the zone I, impervious material. Then rolling with the rubber tired equipment would fill voids and small cracks with the clayey, plastic material and achieve the desired compaction required of the initial fill. The initial fill placed was wet of optimum. See Photos 63 through 77.

6.04 Left Abutment. The foundation treatment on the left abutment between Stas. 29+00 and 32+50 consisted of drilling and grouting 15 EX holes and one NX exploratory grout hole for a total of 670 feet. Fourteen holes were drilled on 40 foot centers along the center line of zone I, core material, with hole No. 32 bracketed about 10 feet on each side, because this 40-foot hole took 30-1/3 sacks of cement. The rock foundation was tight, as

the take of the other holes ranged from 0 to 4-1/4 sacks or an average of 0.08 sacks per foot of hole. The 60 foot exploratory NX grout hole, D-36, took 1-2/3 sacks. After the grouting was completed the area was mapped. See Plates 36, 37, 38, 57 and 58. Final preparation of the abutment included removing all material that was loose or, in the opinion of the project geologist, could break down when wet. All vegetation that had grown on the surface since the grouting operation was removed. Where necessary, irregular surfaces were cut back, shear zones and open joints were cleaned and filled with a sand-cement mortar and larger depressions were backfilled with dental concrete. As for the right abutment, the core zone of the left abutment was closely examined, mapped and approved for each five foot increment and photographed for record of the foundation treatment. This was all completed before any embankment material was placed on the rock surface. See Photos 78 through 83.

OUTLET WORKS

6.05 The foundation treatment of the Outlet Works consisted of drilling and grouting 8 EX holes, 4 holes 10 feet apart on both sides of the conduit, measured both upstream and downstream of the centerline of the core zone. The purpose of this drilling and grouting was to prevent possible seepage paths developing between the rock and the concrete backfill of the conduit. The area was tight, as it took only 4-1/4 sacks of cement for a total of 175 feet of drilling. See Photos 84 and 85. See Plates 19 through 21 and 46 through 49.

DIKE NO. 1

6.06 The foundation treatment for Dike No. 1, between Stas. 33+60 and 42+40, consisted of drilling and grouting 25 EX grout holes, a total of 584 feet. Twenty-three holes were drilled on 40 foot centers along the centerline of Dike No. 1 and two additional holes bracketed hole No. 2, approximately 10 feet on each side. These extra grout holes were drilled because of the 6-2/3 sacks of cement used in the 25 feet of hole No. 2. The average grout take for all grout holes was 0.04 sacks per foot of hole. The rock foundation was tight. The only problem encountered, was the surface seeps, caused by the fractured rock formation and the near surface caving conditions in most of the holes. This condition was resolved by puddling grout at the surface to seal the surface fractures. The holes were filled to the ground surface by hand and the pipe above ground surface was cut before embankment fill was placed. The relief of the rock surface was so gentle, that only one small area on the right side of the dike (Sta. 35+50) required treatment with dental concrete. See Photos 86 and 87. See Plates 11, 12, 13 and 39 through 43, 57 and 58.

DIKE NO. 2

6.07 The foundation treatment for Dike No. 2, between Stas. 51+00 and 53+30, consisted of drilling and grouting 7 EX holes for a total of 175 feet. These holes were drilled on the right abutment of the dike and spaced 40 feet apart using a total of 4 sacks of cement for an average take of 0.03 sacks per foot of hole. This indicated that the formation was very tight. No further surface treatment was necessary other than recleaning the surface with high pressure air prior to placing embankment material. See Photos 88 and 89. See Plates 15, 44, 45, 57 and 58.

Spillway

6.08 The trench excavated for the control sill provided a satisfactory rock foundation for placing reinforcing steel and concrete. The sill with the side extensions at each end are expected to maintain the cross section required. See Photos 90 through 94. See Plates 16 through 18 and 50 through 58.

Bypass Channel.

6.09 No foundation treatment was required for the bypass channel.

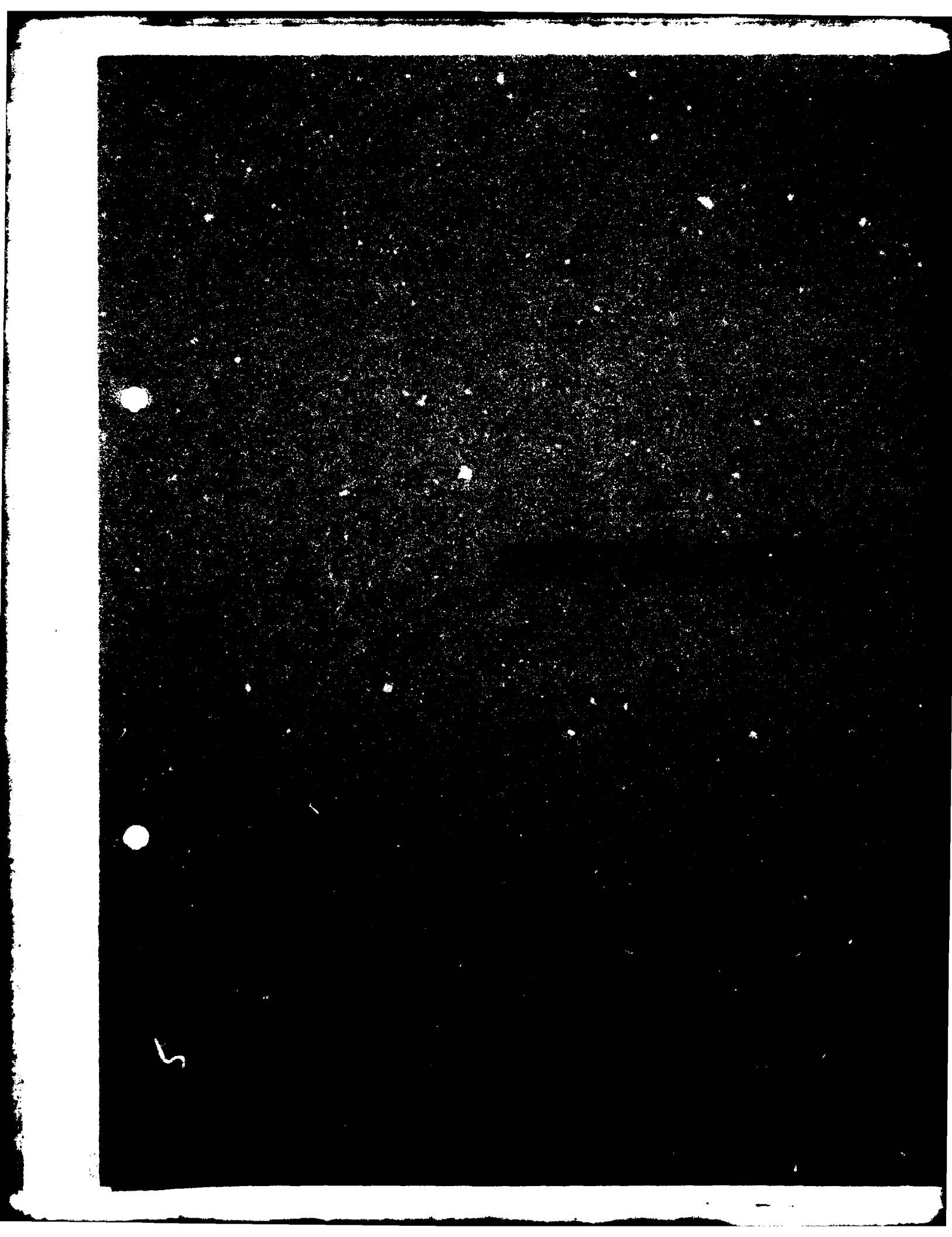




Photo 1 Center outlet of Cave Creek Dam. Lake elevation is 1,627 feet; release of 500 cfs.

1 Mar 78



Photo 2 Outlet Works centerline, upstream from centerline of dam. Ponds from recent rain.

1 Mar 78



Photo 3 Diversion of water through construction,
toe of right abutment, upstream of center-
line of dam.

17 Jan 78

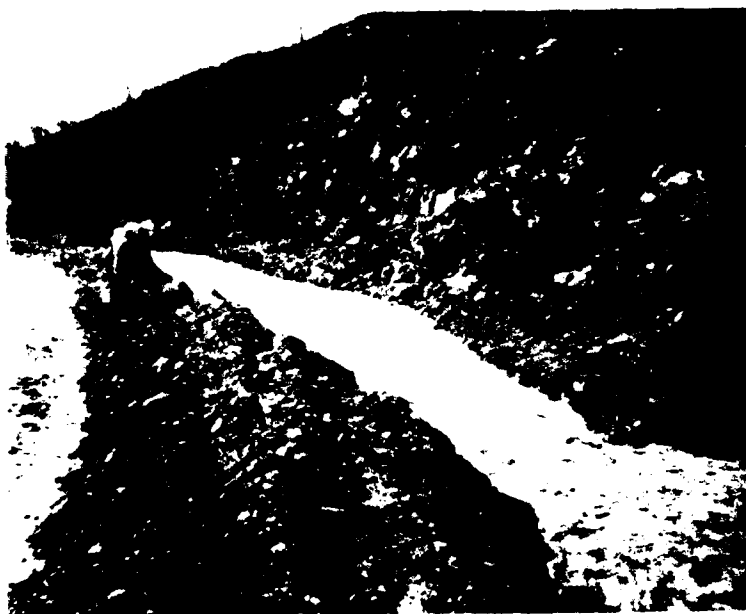


Photo 4 Diversion of water through construction,
toe of right abutment, downstream of
centerline of dam.

17 Jan 78



Photo 5 Diversion of 1500 cfs along toe of right abutment. View is up channel to the north.
2 Mar 78



Photo 6 Diversion of 1500 cfs along toe of right abutment. View is down channel to the south.
2 Mar 78



Photo 7

Core trench. Looking east from top of diversion dike. Contractor trying to remove water from trench.

21 Mar 78



Photo 8

Core trench. Looking west. Contractor trying to drain water accumulated from rain and seepage.

21 Mar 78



Photo 9 Slight seep at elevation 1,538± in downstream part
of cutoff trench, near right abutment.

19 Oct 78



Photo 10

Seep in bottom of
cutoff trench at rock
knob, Sta. 27+50.

12 July 78



Photo 11

Downstream side of
cutoff trench, Sta.
21+05. Salt cedar
growth along seepage
at top of bedrock.

19 July 78

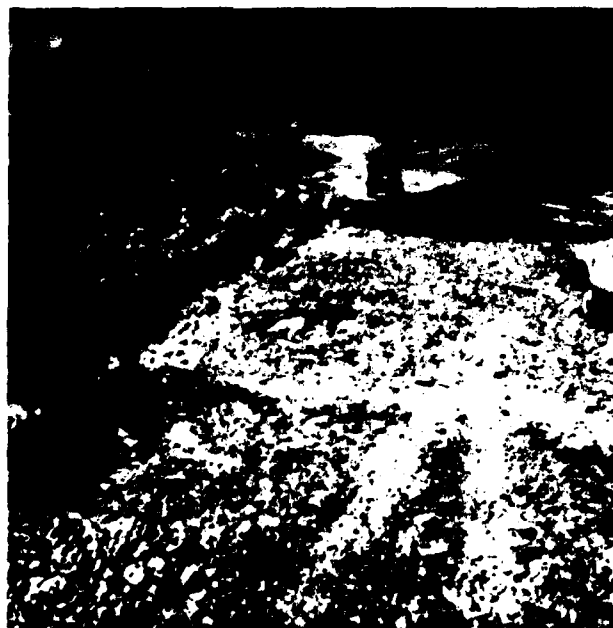


Photo 12

Cutoff trench.
Drainage ditch along
downstream toe of
trench.

6 Apr 78

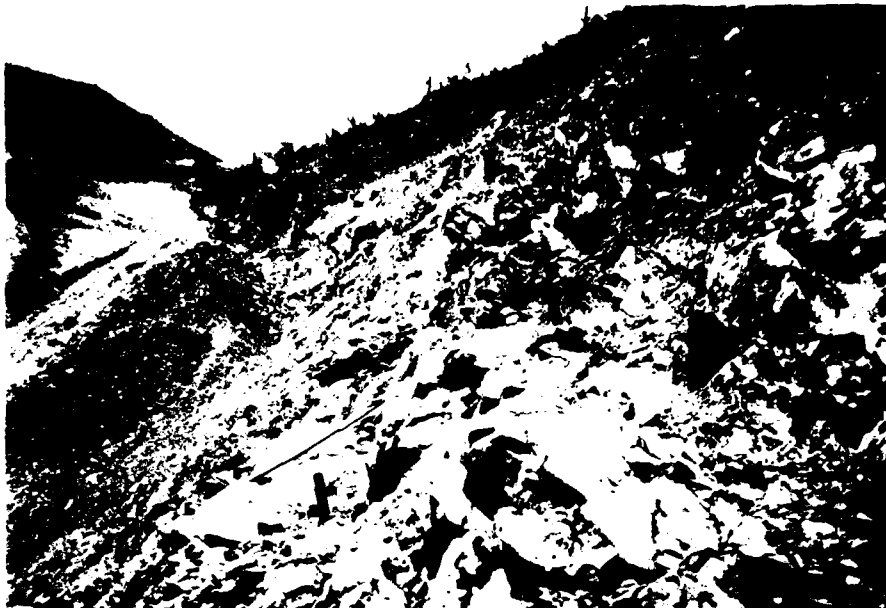


Photo 13 Right Abutment. View downstream of toe along diversion ditch. Scaling is completed; 1V on 1H in core zone and 1.5V on 1H in downstream zone II.

4 May 78



Photo 14 Cave Buttes Dam, right (west) abutment.

16 Jan 78

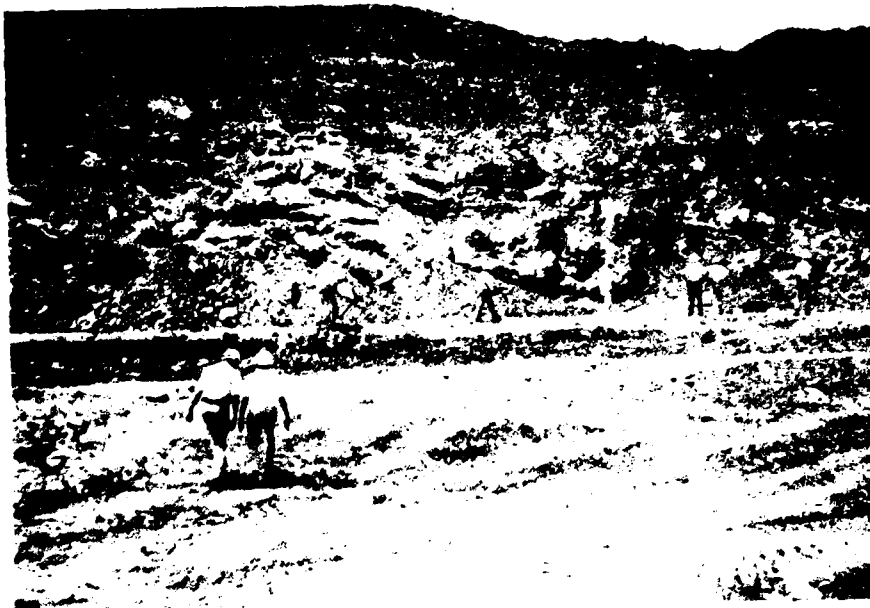


Photo 15 Cave Buttes Dam, right (west) abutment area of downstream zone II.

16 Jan 78



Photo 16

Right abutment.
Drilling holes on
 $2\frac{1}{2}$ foot centers
for scaling.

25 Jan 78

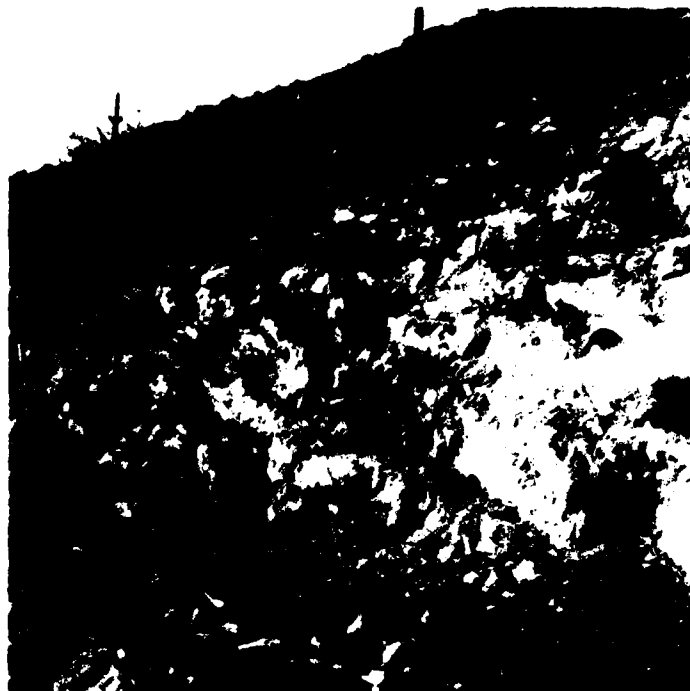


Photo 17

Right abutment.
Holes drilled on 2½
foot centers for
scaling using 40%
gel. Downstream
zone II, elev. 1,5670±.
25 Jan 78



Photo 18 Right abutment. View looking west during
early stage of cleaning operations.
17 Jan 78



Photo 19 Left abutment. Approximate centerline of
zone I foundation from near top of dam.
20 Dec 77



Photo 20 Left abutment. Contact between zone I and zone II
foundations. Dental clean up between elevations
1,565 and 1,570.

31 Oct 78



Photo 21 Left abutment. Upstream side of zone I foundation, elevation 1,575 to 1, 585; removal of fragmented rock in well-cemented sandy matrix.

31 Oct 78



Photo 22

Left abutment.
Cleaning completed
in upper part, cen-
ter of zone I found-
ation.

16 Jan 78



Photo 23

Left abutment.
Cleaning completed
in upper part,
center of zone I
foundation.

16 Jan 78



Photo 24

Left abutment.
View east along
centerline of dam.
Presplit holes can
be seen in hard
rock of outlet.

21 Mar 78



Photo 25

Left abutment to distant right abutment. View of cutoff trench. Grouting in center at Sta. 23+20.

4 May 78

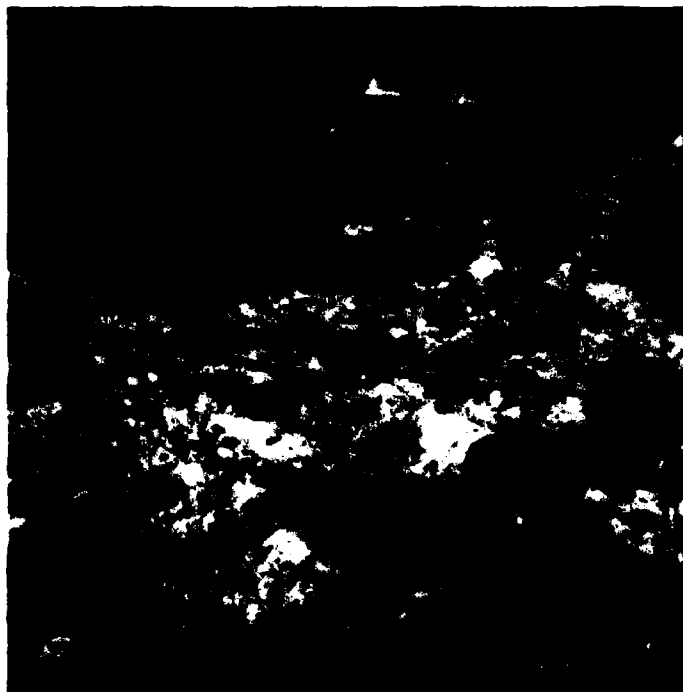


Photo 26

Cutoff trench. Cleaning by high pressure air before grouting.

24 Apr 78



Photo 27

Cutoff trench.
Cleaning by high
pressure air be-
fore grouting.
24 Apr 78



Photo 28

Cutoff trench near
base of right abut-
ment. Mr. Hadsall
standing on last
grout hole drilled,
3 more left to drill.
12 July 78



Photo 29

Outlet Works.
View north from
downstream of energy
dissipator site.

21 Mar 78

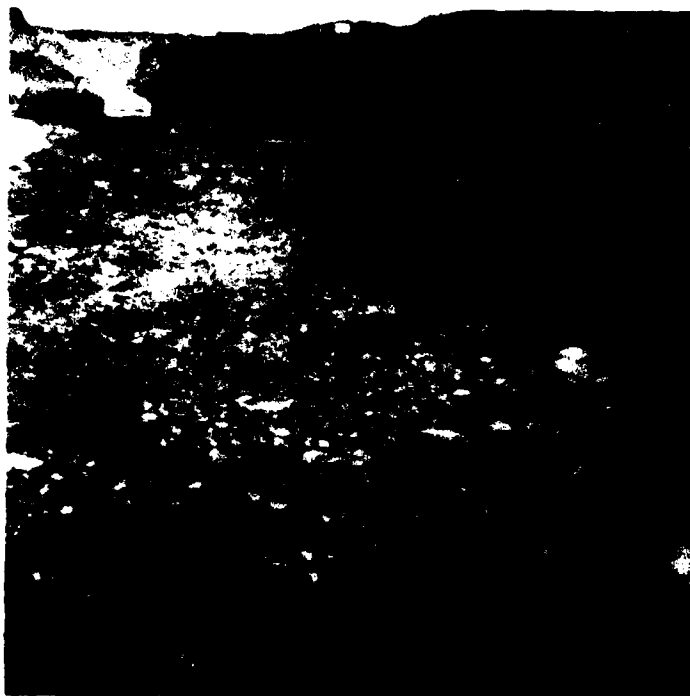


Photo 30

Outlet Works.
Centerline view
upstream toward
intake site.

15 Feb 78



Photo 31

Outlet Works.
Sta. 54+00, cut for
retaining wall of
intake.

15 Feb 78

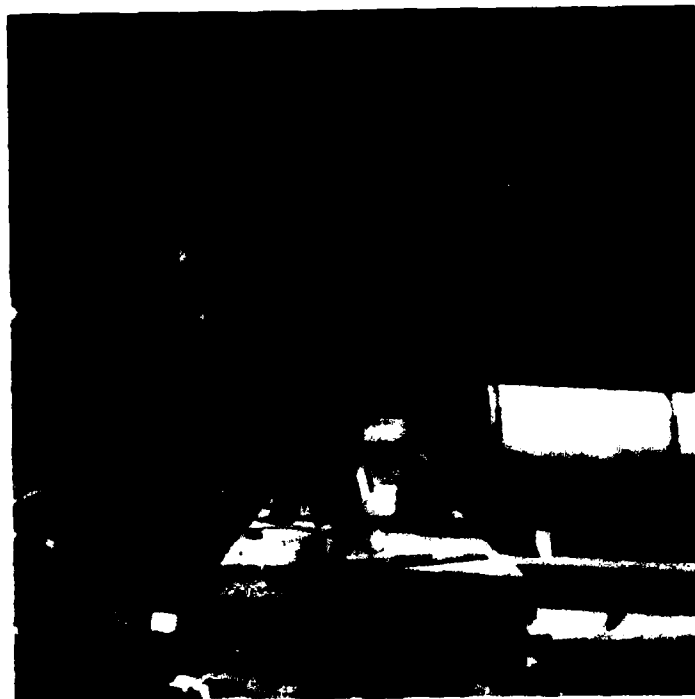


Photo 32

Outlet Works.
Intake retaining
wall and conduit,
Sta. 53+92.5.

4 June 78



Photo 33

Outlet Works, downstream of centerline of dam. Stakes are on outlet centerline. Drilling is for pre-splitting along side wall.

15 Feb 78



Photo 34

Outlet Works.
Base for conduit.
View downstream
from Sta. 51+50.

21 Mar 78



Photo 35

Outlet Works.
Setting conduit,
view upstream from
outlet Sta. 51+50.
6 Apr 78



Photo 36

Outlet Works.
Same as photo 35
except view is along
the west side.
6 Apr 78



Photo 37

Outlet Works.
Sta. 50+00 after
cleaning and before
setting forms for
backfilling with
lean concrete.

24 Apr 78



Photo 38

Outlet Works.
Excavation for
outlet wall, down-
stream of energy
dissipator.

21 Mar 78



Photo 39 Outlet Works. Portion of concrete backfill near Sta. 50+00 to restore proposed foundation grade.
4 May 78



Photo 40 Outlet Works. Downstream portal and excavation for outlet channel.

1 Nov 78

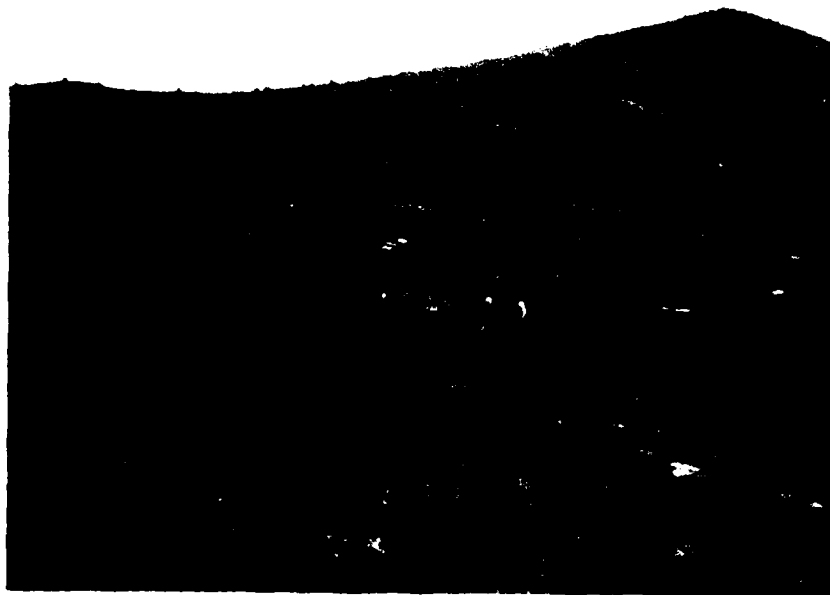


Photo 41 Dike No. 1, looking east.

16 Jan 78



Photo 42 Dike No. 1, looking east.

16 Jan 78

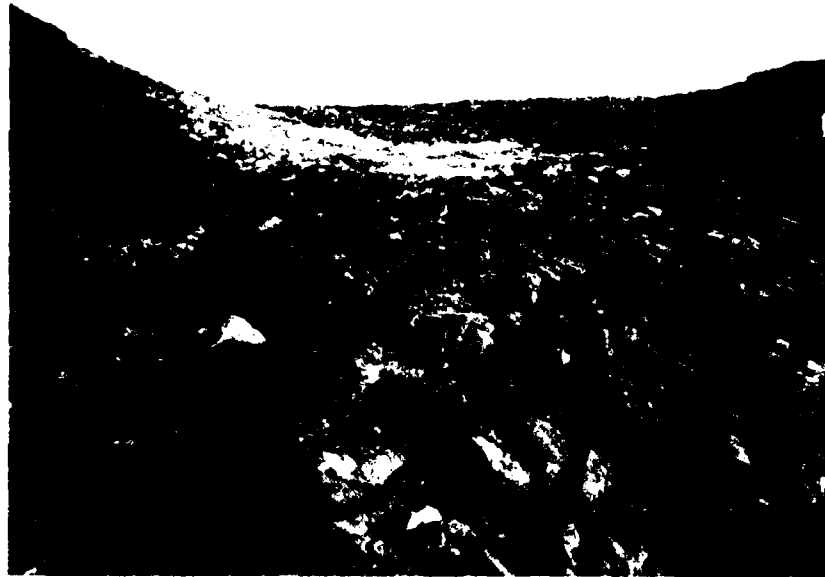


Photo 43 Dike No. 1, right side.

16 Jan 78



Photo 44 Dike No. 2, right abutment.

16 Jan 78



Photo 45

Dike No. 2.
Right abutment,
view west from
Sta. 54+00.

21 Mar 78



Photo 46

Dike No. 2.
Right side after
excavation half
way up abutment.

4 May 78



Photo 47 Spillway. Upstream right (west) side. Excavation by ripping with localized blasting.

4 May 78



Photo 48 Spillway. Upstream right side, approximately 15 to 18 foot cut in center area.

4 May 78



Photo 49

Spillway.
Ripping to
excavate schist
bedrock.

6 Apr 78

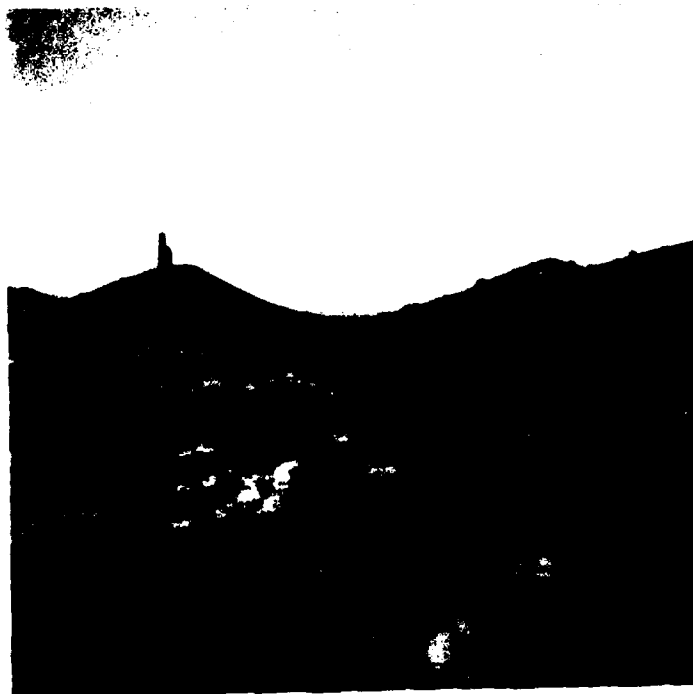


Photo 50

Spillway.
View downstream,
CP drill working
on blast hole.

6 Apr 78

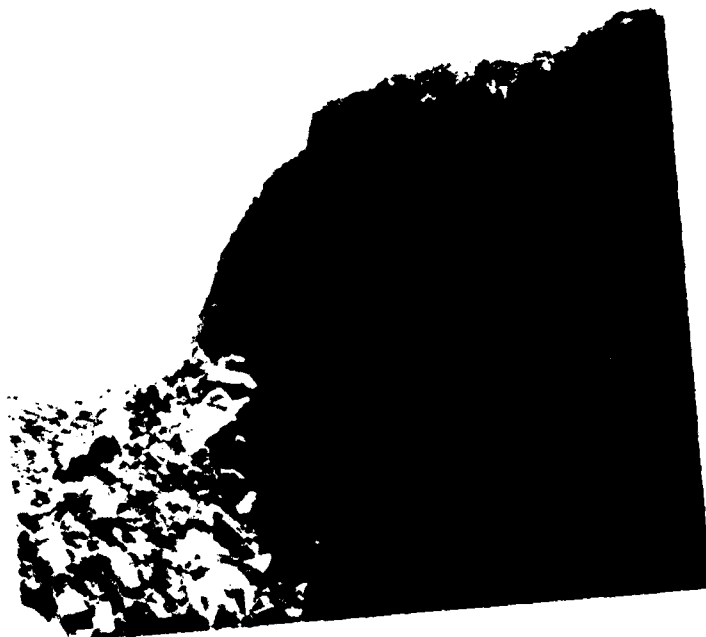


Photo 51

Spillway. Final
cut. Split spacing
drilled on 1-foot
centers.

7 Apr 78



Photo 52 Spillway crest, excavation for sill. View looking
west.

16 Mar 79



Photo 53 Spillway crest. Left (east) wall after cleaning to remove loose rock; overbreak is at notch for vertical extension of sill.

1 Mar 79

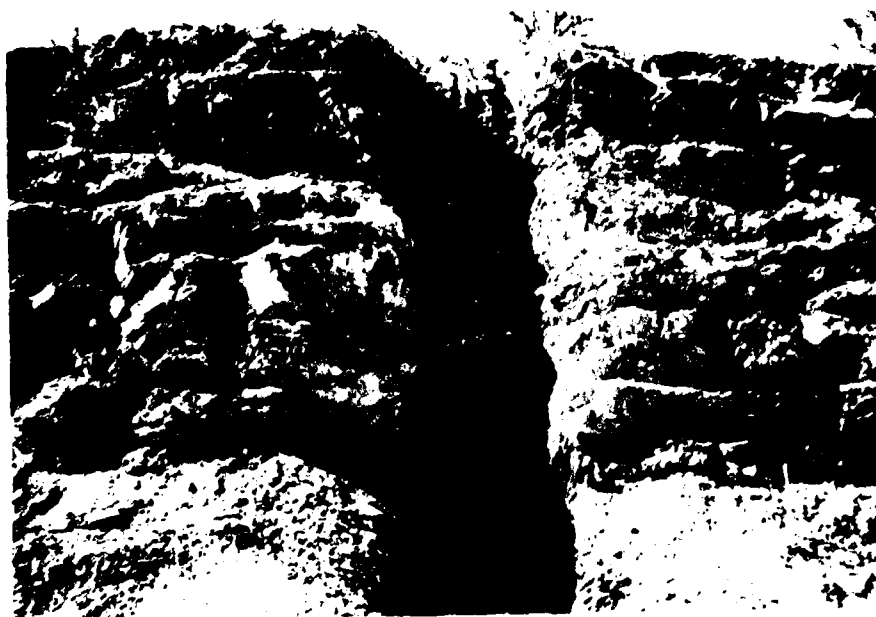


Photo 54 Spillway crest. Right (west) wall, excavation for end of sill and the vertical extension.

7 Mar 79

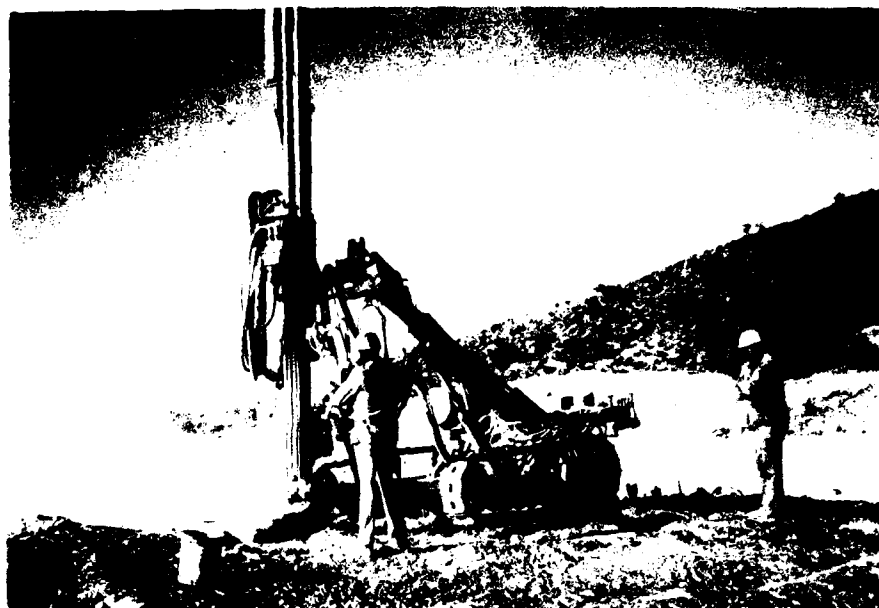


Photo 55 Spillway crest, Sta. 18+00. Drilling holes 5 feet deep on 1-foot centers for controlled blasting of sill trench.

8 Dec 78



Photo 56 Spillway crest. Controlled blasting for sill trench. Charges are set in alternate holes which are line drilled on 1-foot centers to 5 foot depths.

8 Dec 78



Photo 57 Bypass channel. View looking upstream.

13 July 79



Photo 58 Bypass channel. Looking west along crest. Drilling for blast holes.

13 July 79



Photo 59 Right (west) abutment. View upstream of foundation treatment between elevations 1,540 to 1,550.

27 Oct 78

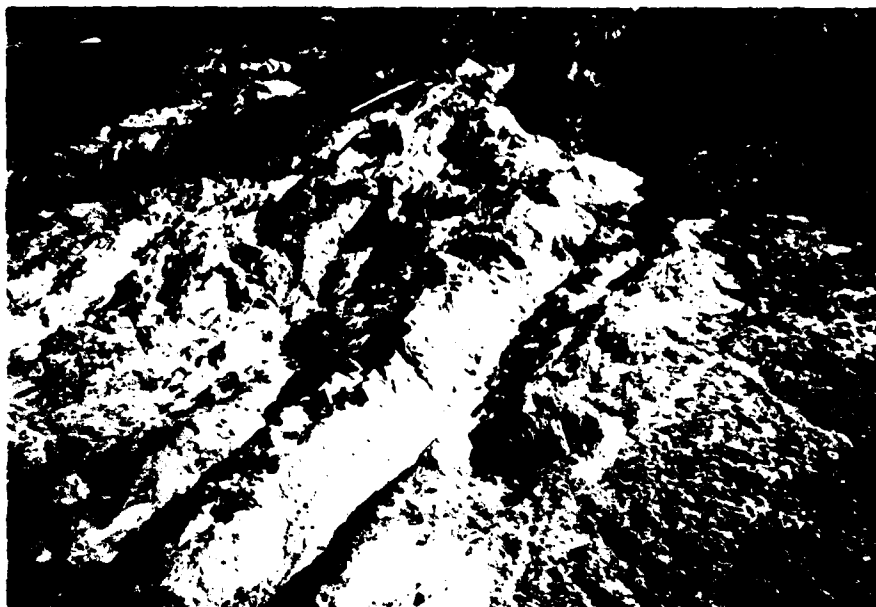


Photo 60 Right abutment. Detail of dental and mortar treatment between elevations 1,540 to 1,550.

27 Oct 78



Photo 61 Right abutment, foundation treatment. Dental concrete and sand-cement slurry grout. Looking downstream, elevation 1,550.

1 Nov 78



Photo 62

Right abutment.
Drilling grout
holes.

12 Apr 78



Photo 63 Cutoff trench. View east toward left abutment.
Clean up and grouting in bottom of trench.

4 May 78



Photo 64

Cutoff trench.
Drilling grout hole.
Water puddle is from
drilling operations.

4 May 78

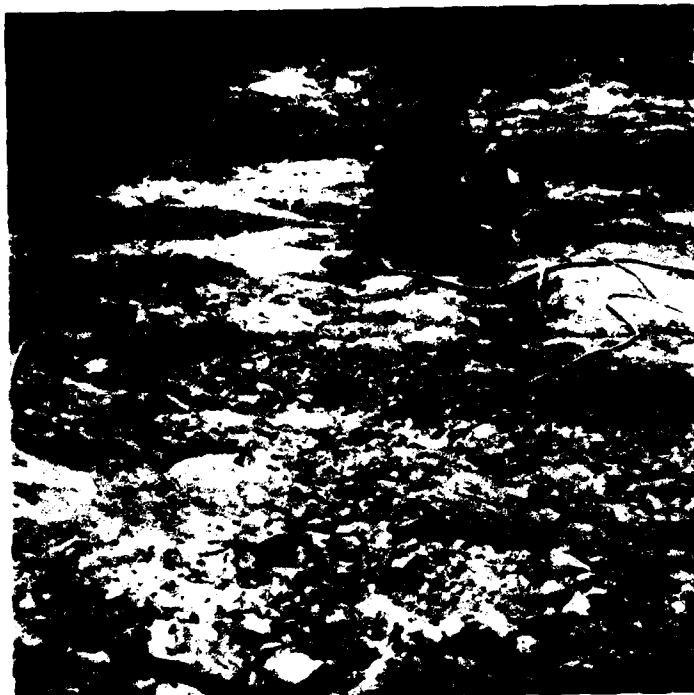


Photo 65

Cutoff trench,
west side. CP
drill on grout
hole location.

14 June 78



Photo 66

Cutoff trench.
Dental concrete
at Sta. 14+50.

19 July 78



Photo 67 Cutoff trench. Dental concrete on upstream side between Stas. 18+50 and 20+00.

8 Aug 78



Photo 68

Cutoff trench.
Dental concrete at
Sta. 24+82, down-
stream from grout
curtain.

12 July 78



Photo 69 Cutoff trench. Grouting to cut off seepage at Sta. 28+50.

8 Aug 78



Photo 70

Cutoff trench.
Placing dental
concrete.

19 July 78



Photo 71

Cutoff trench.
Placing dental
concrete.

19 July 78



Photo 72

Cutoff trench.
Dental concrete
and slurry grout
near Sta. 27+00.
Start of core mat-
erial placement.

8 Aug 78



Photo 73

Cutoff trench.
Slurry grout and
dental concrete.
19 July 78



Photo 74 Cutoff trench. Foundation treatment at elevation
1,550 to 1,560, below outlet works.

28 Oct 78

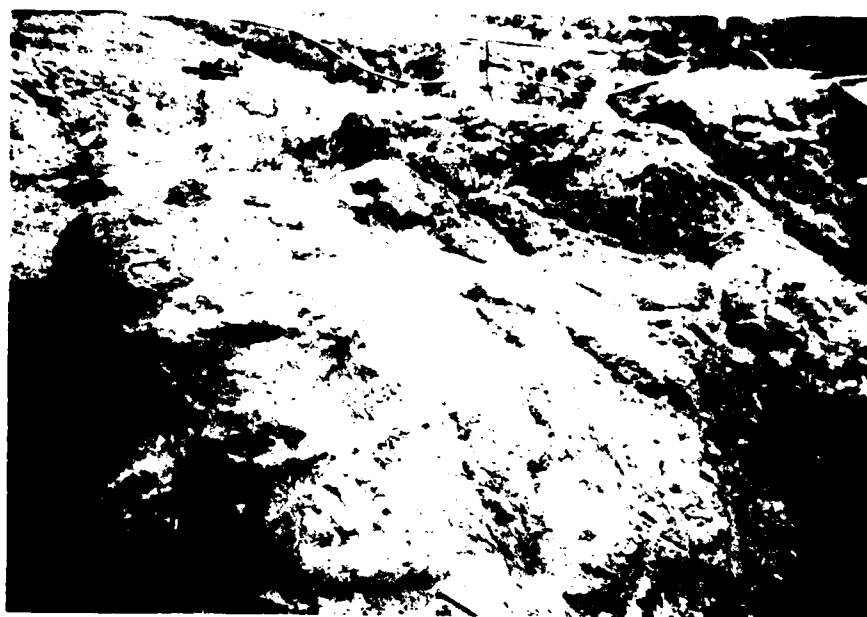


Photo 75 Cutoff trench. Foundation treatment at elevation 1,550 to 1,560, below outlet works. View is to the immediate right of photo 74.

28 Oct 78



Photo 76 Cutoff trench. Rock surface near right abutment. Water seep found during cleaning before grouting.

22 June 78



Photo 77 Cutoff trench. Panoramic view of left abutment (elevation 1,545 to 1,565) after foundation treatment. Top of outlet concrete is at elevation 1,565.

23 Oct 78

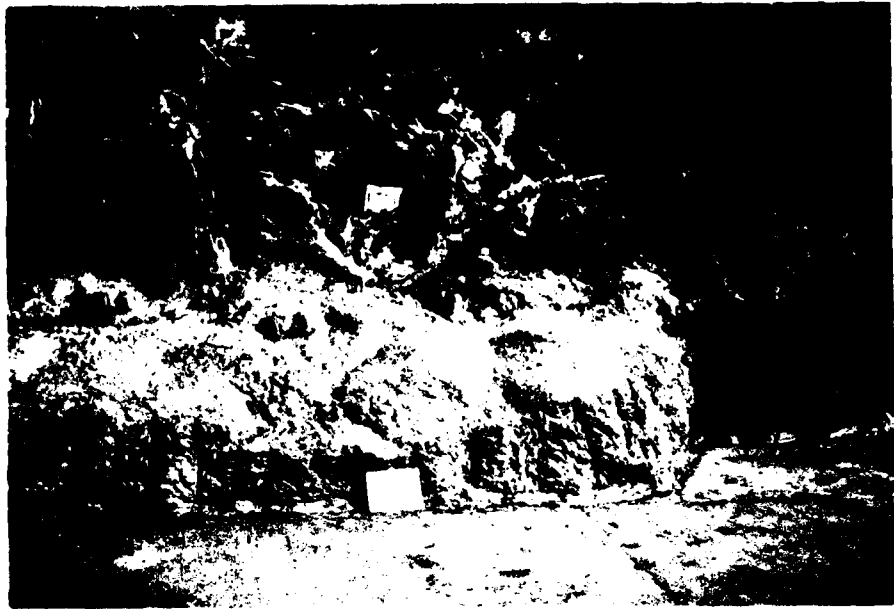


Photo 78 Left abutment, foundation treatment. Elevation 1,565 to 1,570; downstream edge of zone I foundation in near right edge of photo.

31 Oct 78



Photo 79 Left abutment between elevation 1,550 to 1,555. Foreman and crew mixing mortar and pea gravel concrete from dry pre-mixed bags for use as slurry grout to fill holes and deep fractures.

23 Oct 78



Photo 80 Left abutment. Foundation treatment in core zone between elevations 1,550 and 1,560.

23 Oct 78



Photo 81 Left abutment. Dental concrete above outlet at elevation 1,565. View is upstream at zone I - zone II contact.

18 Oct 78



Photo 82 Left abutment. Grout hole No. 6-63 at Sta. 29+09.
Material is well cemented gravels and cobbles.
8 Aug 78



Photo 83 Left abutment after cleaning and during grouting.
8 Aug 78

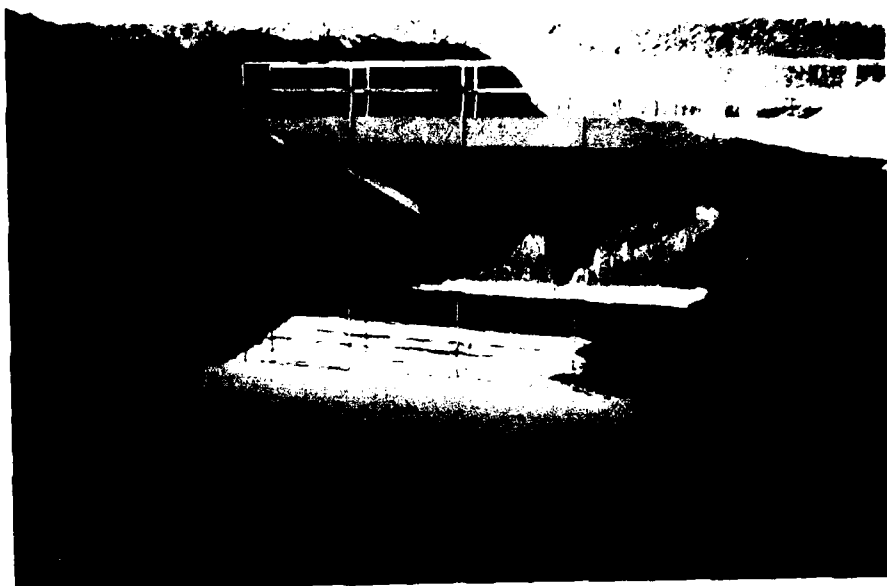


Photo 84 Outlet channel. View upstream toward beginning of of channel. Footbridge, energy dissipator and skyline of embankment at elevation 1,595.

11 Dec 78



Photo 85 Outlet channel. View downstream toward end of conduit, energy dissipator, bridge and beginning of channel. Camera point is on embankment at elevation 1,595.

12 Dec 78



Photo 86

Dike No. 1. CP
drill setting pipe
for grout holes in
the zone II area.
25 Jan 78



Photo 87

Dike No. 1.
Pressure grouting
with neat cement
grout.
3 Feb 78



Photo 88 Dike No. 2. Elevation 1,650, west abutment. View looking east.

7 May 79



Photo 89 Dike No. 2. Elevation 1,650, west abutment. View looking east.

7 May 79



Photo 90

Spillway crest.
Setting steel in
trench for sill.
28 Mar 79



Photo 91 Spillway crest. Placing concrete in sill.
9 Apr 79

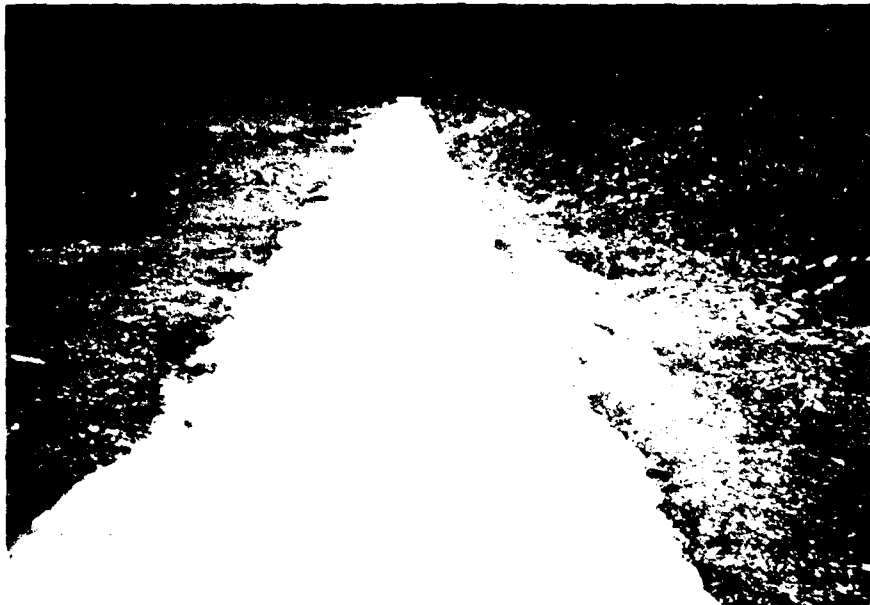


Photo 92 Spillway crest. Concrete in place along sill.
View looking west.

10 Apr 79

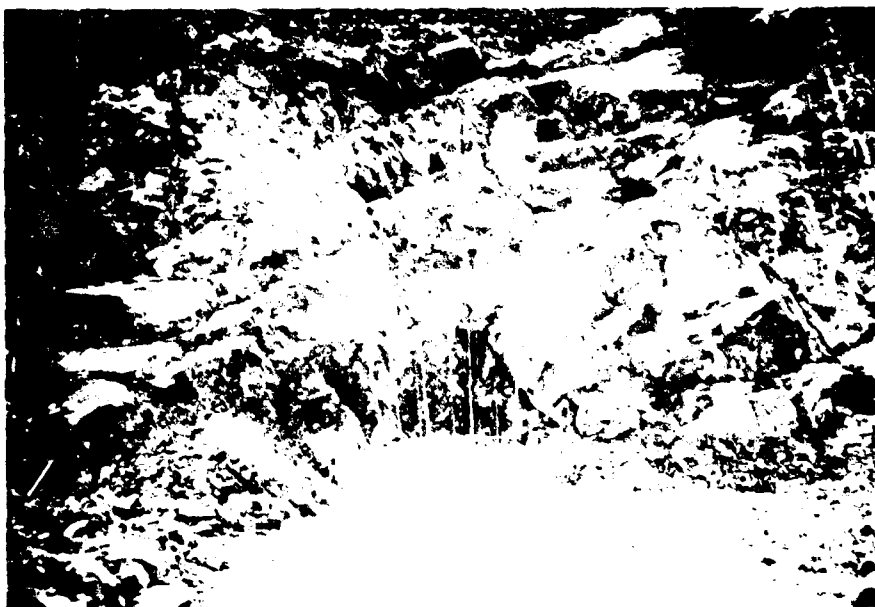


Photo 93 Spillway crest. East end of sill, some steel for
upright extention but no forms through overbreak.

10 Apr 79

AD-A137 732

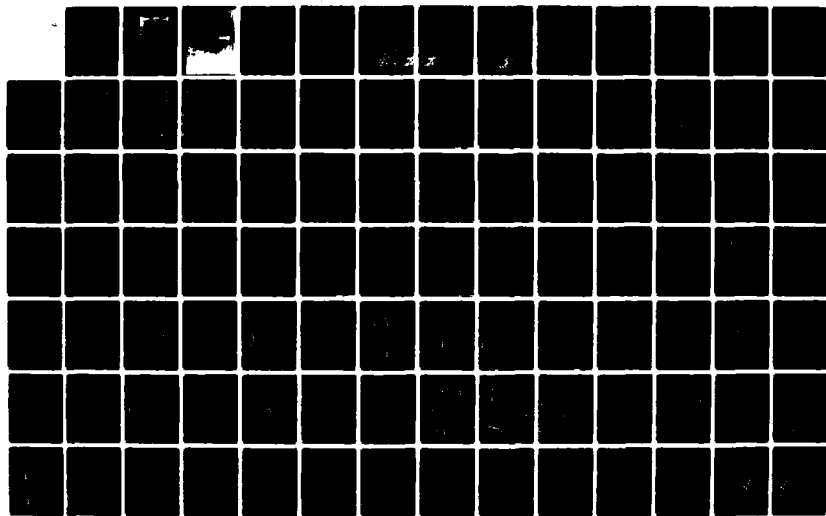
CAVE BUTTES DAM FOUNDATION REPORT GILA RIVER BASIN:
PHOENIX ARIZONA AND VICINITY (INCLUDING NEW RIVER)(U)
ARMY ENGINEER DISTRICT LOS ANGELES CA AUG 83

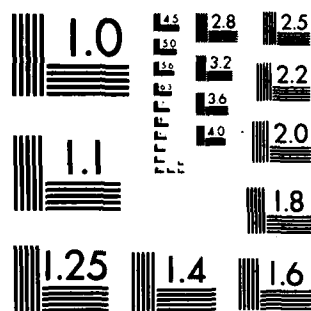
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

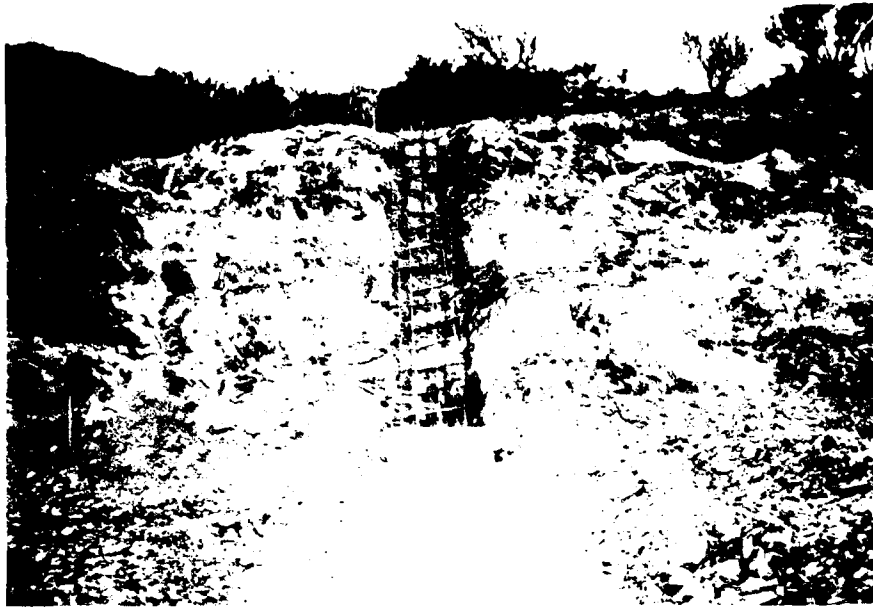
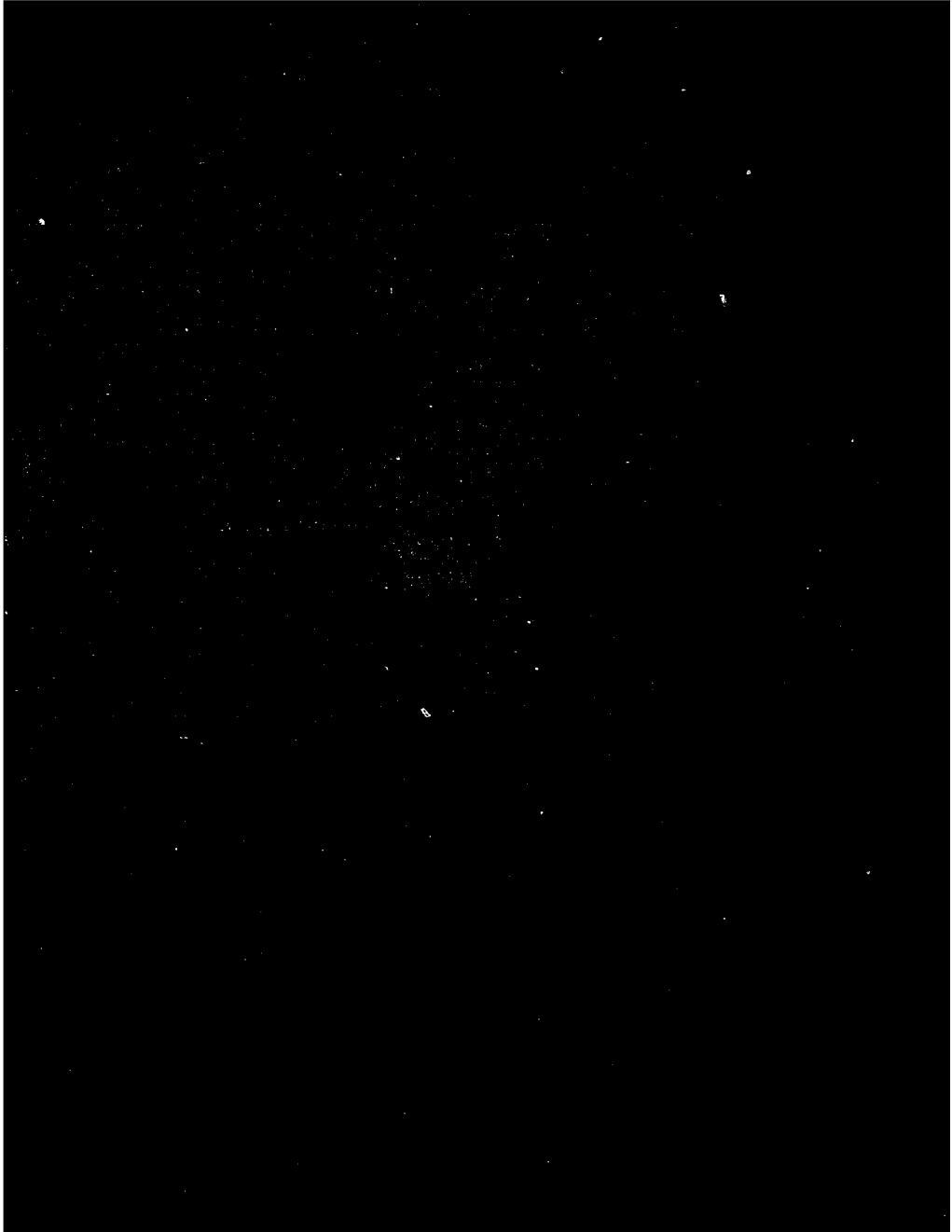
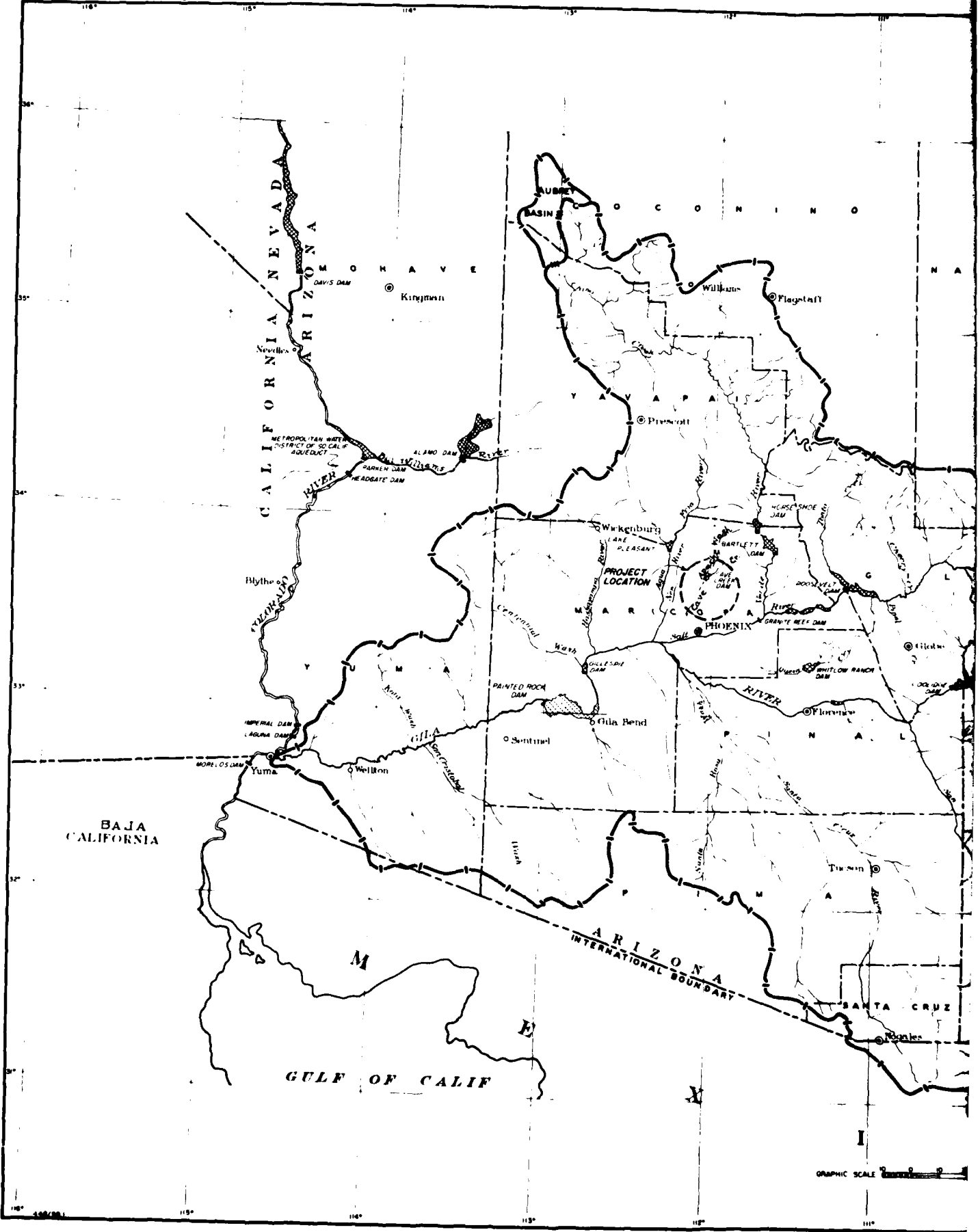
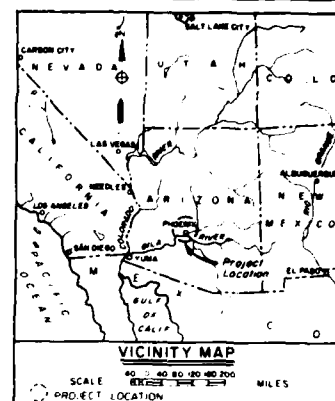
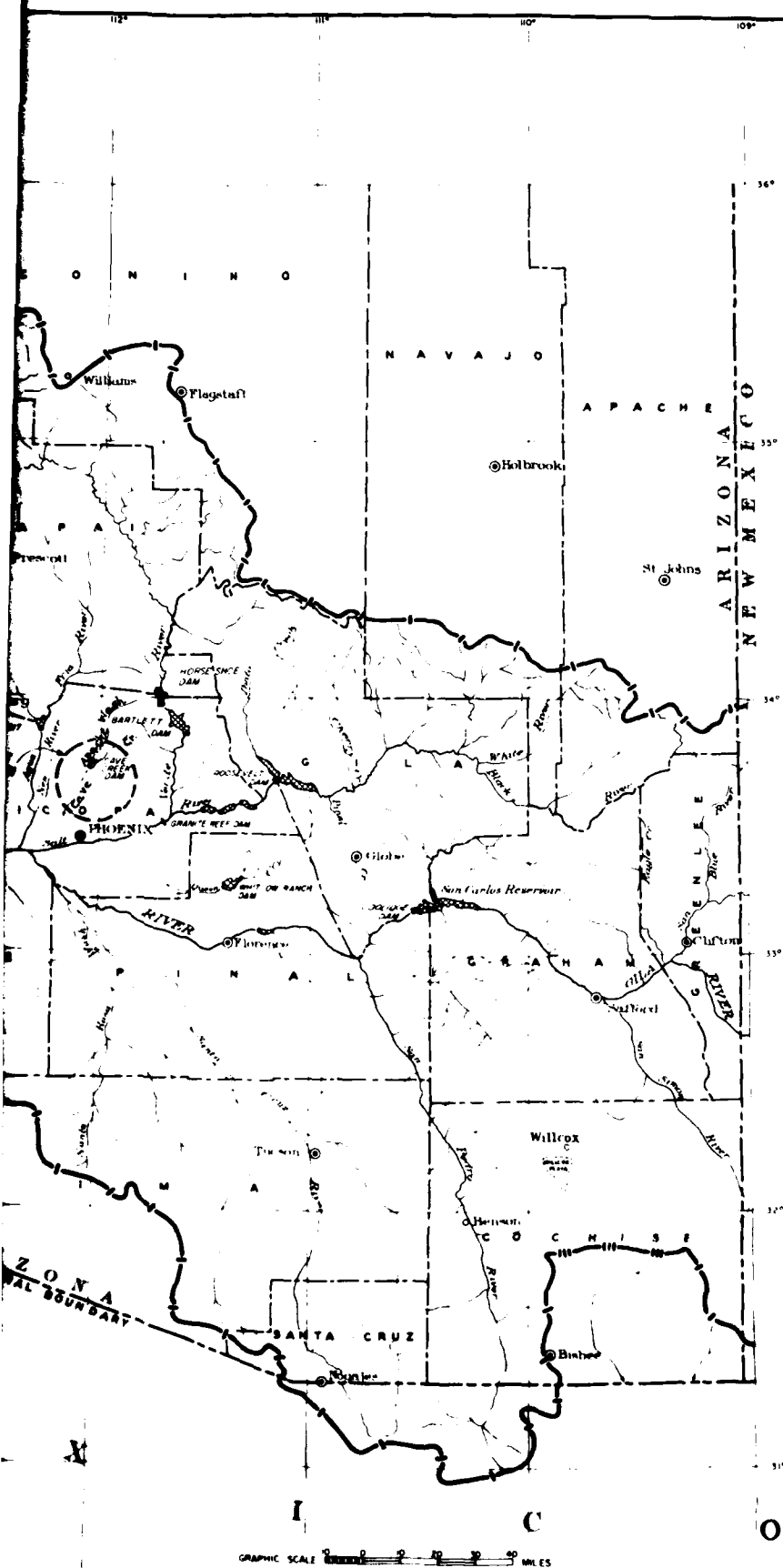


Photo 94 Spillway crest. Steel set for upright extension
of sill.

10 Apr 79

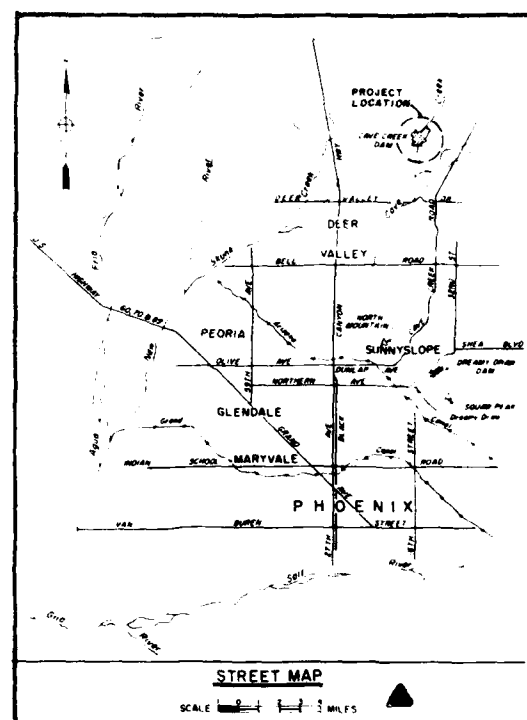




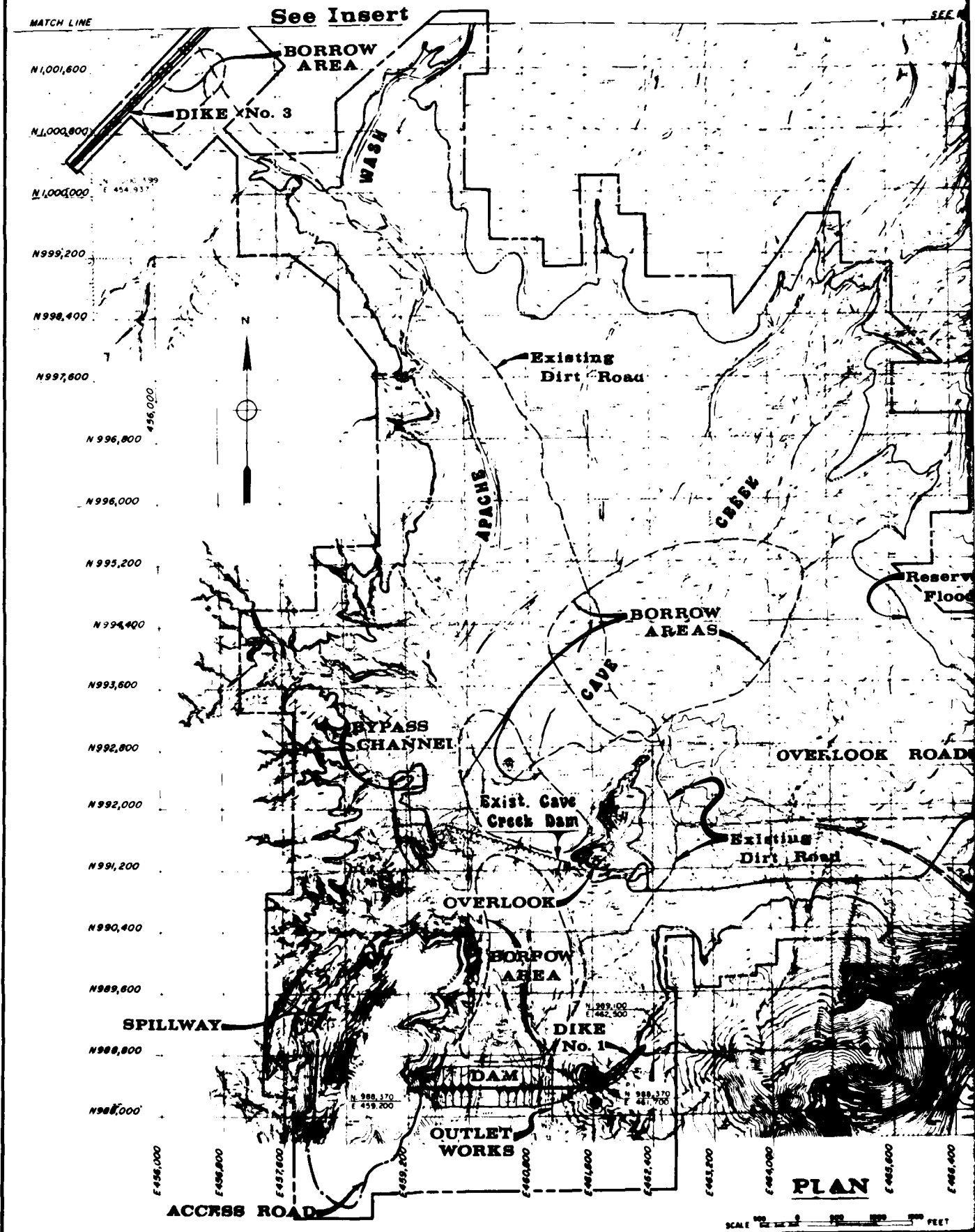


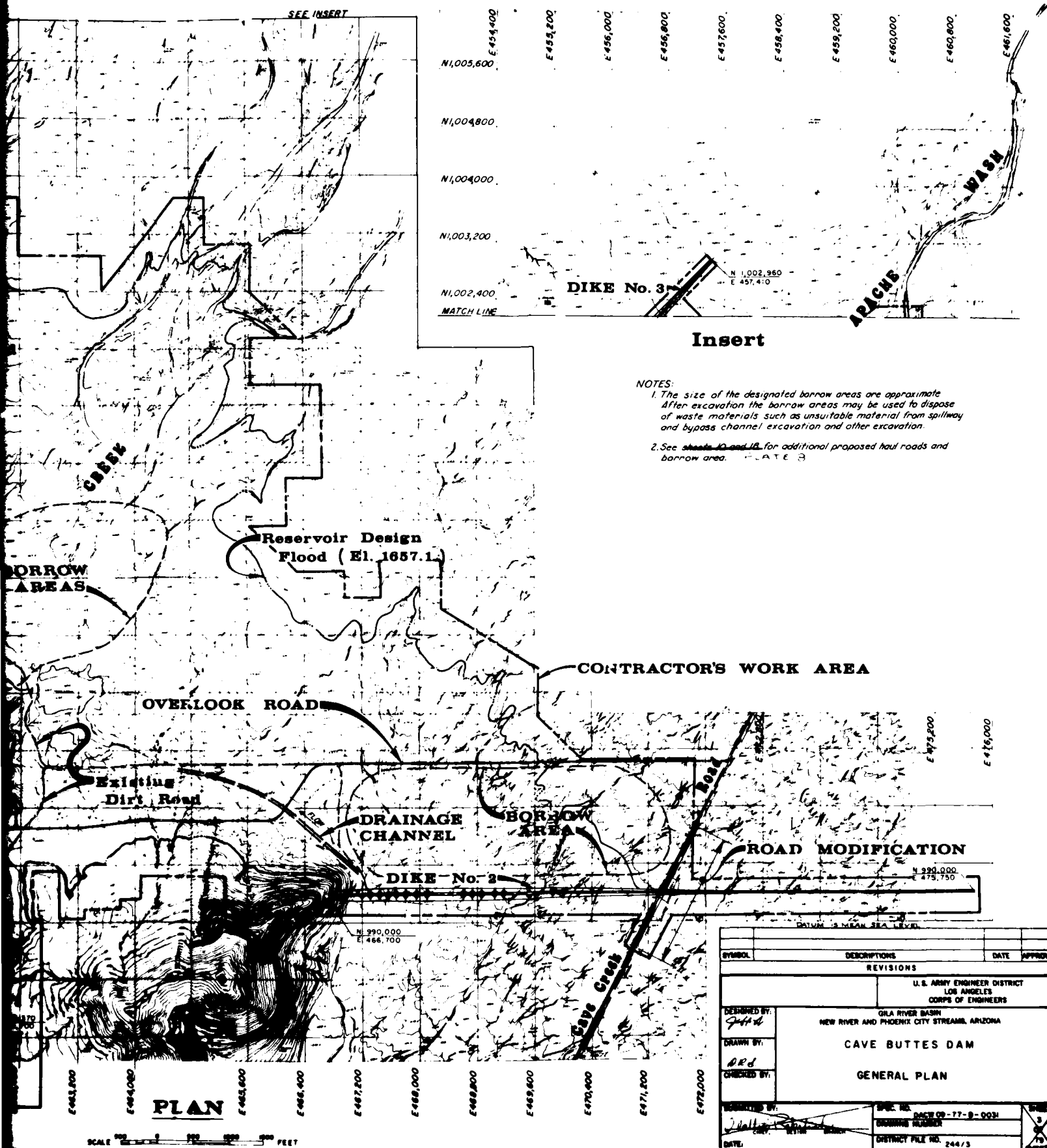
LEGEND

- BOUNDARY OF GILA RIVER DRAINAGE AREA
- BOUNDARY OF EFFECTIVE AREA
- ◼ EXISTING DAM AND RESERVOIR



Added Street map		5 Aug 77	2nd R
SYMBOL	REVISIONS	DATE	APPROVAL
U.S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS			
GILA RIVER BASIN NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA			
CAVE BUTTES DAM			
PROJECT LOCATION			
DESIGNED BY	APPROVED		
DRAWN BY	SPEC. NO. DACW 69-77-8-003		
CHECKED BY	DISTRICT FILE NO. 24472 REV 74		
RECOMMENDED	APPROVED		





SCALE: 1 IN. = 100 FT
CONTOUR INTERVAL: 4 FT

LEGEND

- Qal QUATERNARY RECENT ALLUVIUM.
Streambed and flood-plain deposits, clay, silt, sand, gravel, cobbles, and boulders, unconsolidated
- Qoal QUATERNARY OLDER ALLUVIUM Slope wash, residual soil, and talus debris, silt, sand, gravel and cobbles, occasional lenses of cemented materials
- QTl QUATERNARY OR TERTIARY TUFFACEOUS AGGLOMERATE Buff to light brown, subangular to angular rock fragments well cemented in a tuffaceous matrix; rock fragments are generally green metageneous basement complex rocks which go to cobble size
- Gr PRECAMBRIAN GRANITE Light brown to pink, moderately hard to hard, medium to coarse grained, closely fractured of surface
- BC PRECAMBRIAN BASEMENT COMPLEX Green metageneous rock, greenstone is moderately hard to hard, light dark green, fine to medium grained, fracturing occurs mostly along older, cemented fractures, schistose intervals are light to brownish green, moderately hard to soft, platy and cleavable, slightly weathered near surface, occasional altered zones of alic and clay, foliation dips 45 to 90°, but mostly 60 to 90°

LEGEND

- T-5-2 Test trench
- D-6u Diamond drill hole, vertical
- D-12u Diamond drill hole, inclined
- Fault (showing dip) dashed where approximately located, dotted where evidence uncertain. Long arrows indicate direction of relative movement
- Strike of vertical foliation
- Strike and dip of inclined foliation
- Strike and dip of inclined joint
- Strike of vertical joint
- Contact between alluvium and bedrock, or between various types of bedrock

GENERAL NOTES

- PLATES 6 AND 7
- 1 See ~~Sheet 6~~ for logs of diamond drill holes
- 2 See ~~Sheet 6~~ for geologic sections A-A through D-D and E-E along E of Dike No. 2

DATUM IS MEAN SEA LEVEL

ADD EXISTING POWER & TELEPHONE LINE TO BE RELOCATED BY OTHERS

17 AUG 77

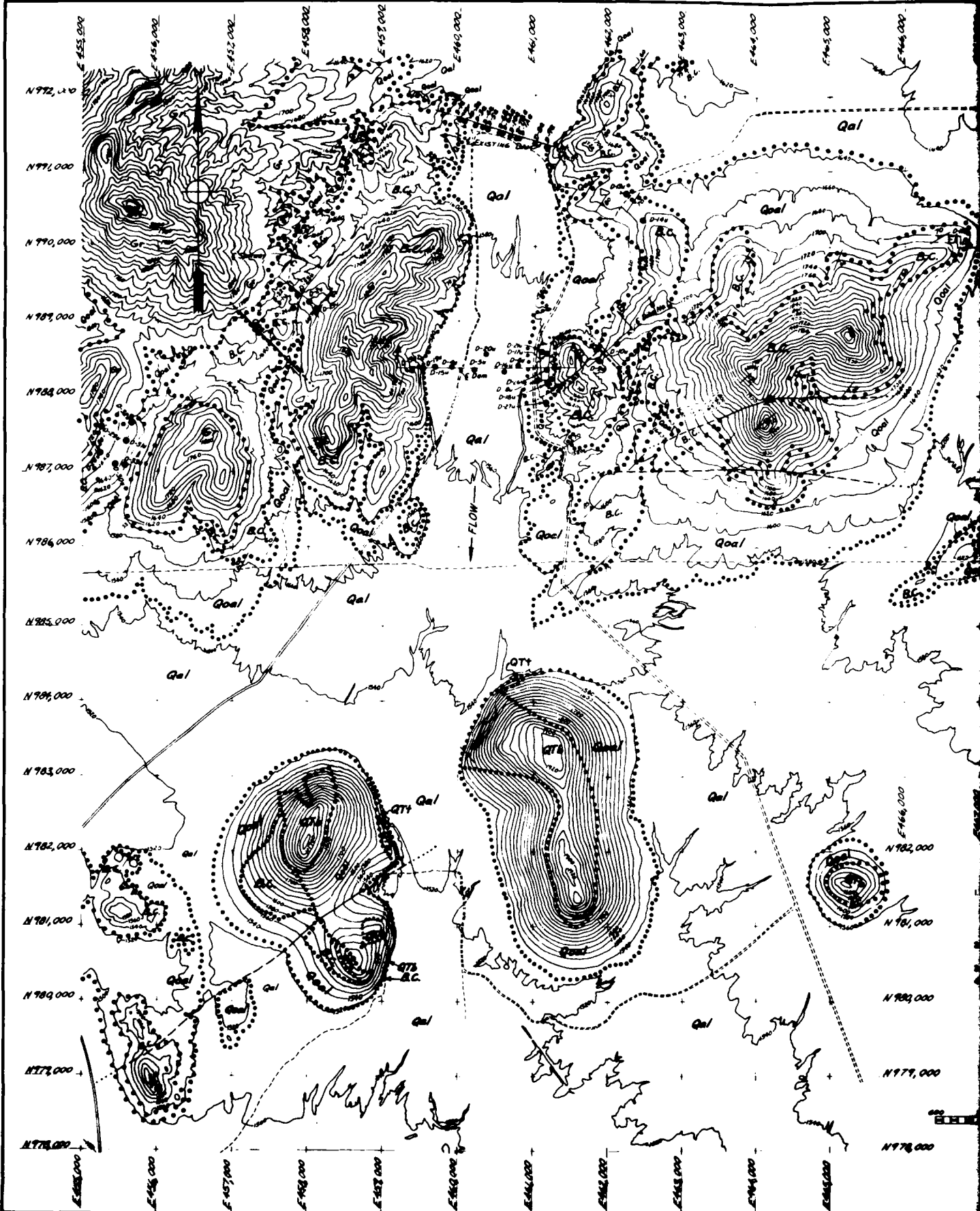
SYMBOL		DESCRIPTIONS		DATE	APPROVAL
REVISIONS					
U.S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS					
DESIGNED BY:	GILA RIVER BASIN NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA				
DRAWN BY:	CAVE BUTTES DAM				
CHECKED BY:	GENERAL				
PLAN OF GEOLOGIC EXPLORATION					
EXAMINED BY:	SPEC. NO.	DASH 00-77-B-0031		SHEET	2
DATE:	DRAWING NUMBER	DISTRICT FILE NO. 244/4		REV. A	1

FOUNDATION REPORT

PLATE 2

2

U.S. ARMY ENGINEER DISTRICT



QUATERNARY- RECENT ALLUVIUM: Streambed sand, silt and unconsolidated, clayey deposits; clay, silt and gravel; cobbles and boulders, generally cemented; also, at occasional intervals and lenses.

QUATERNARY-- RECENT ALLUVIUM: Streambed flood plain and unconsolidated silt, clay, sand, gravel, cobbles and boulders, generally well sorted but occasional cemented intervals and lenses.

QUATERNARY- The R. 2000-0100 terrace slope wash deposits and talus debris of clay silt sand gravel cobbles and boulders, occasional lenses of cemented materials.

QUATERNARY— BASAL: Dark gray or black to reddish brown, fine grained, dense to vesicular
OR commonly amygdaloidal and vuggy, hard and black, to brecciated, occasional
TERTIARY layers of ash, sand, tuff, and tuffaceous agglomerate.

QUATERNARY-- TUFF, AGGLOMERATE, TUFF, AND TUFFACEOUS AGGLOMERATE:
OR light brown to buff, soft to hard, angular to subangular clasts and fragments
TERTIARY of green mudstone, basement, and dense to vesicular basalt (to 10 cm maximum diameter) in fine grained, well-cemented tuffaceous matrix. Material becomes more agglomeratic with increase in depth.

PRECAMBRIAN— GRANITE AND GRANODIORITE, light to dark gray, medium to fine grained contains inclusions of basement rocks. Rock is hard but highly fractured and blocks, slight weathering on fractures.

PRECAMBRIAN— BASEMENT COMPLEX. Ext. gray-green to dark green, metaigneous rocks, soft to hard fine grained, alternately schistose and massive, closely fractured, but mostly along older, recemented fractures, locally meta-andesite.


175? Contact between alluvium and bedrock or between various types of bedrock - dashed, where contact plane is located.

Fault, showing dip — dashed where approximate, dotted where uncertain, arrows indicate direction of relative movement
Part of of diamond drill hole where coring was not done and a thin cone rock bit

was used

CORE LOSS Approximate interval of core loss (in bedrock intervals only)

WATER PRESSURE TESTS

	<p>PRESSURE TEST: Accomplished using single packer</p> <p>DEPTH: Number of feet below color of hole</p> <p>PSI: Pounds per square inch (water pressure)</p> <p>GPM: Gallons per minute water loss</p> <p>NO TEST: Internal not tested</p> <p>WATER LOSS: No water loss at certain pressure</p> <p>PACKER LEAKED: Water leaked around packer</p>
---	--

L 75°)
D-26 (PROJ.)

Diamond drill holes, inclined and vertical - dashed = where projected

D-13u D-5e

GENERAL NOTES

This sheet shows all dam drill holes drilled at the dam site and at the existing Love Creek Dam holes drilled at the existing dam have an "e" after the hole number. Holes drilled at the dam have an "u" after the hole number.

2 See § 101.10 for economic term

2. See *United States v. Galt*, 199 F.2d 1047, 1051 (9th Cir. 1955).

3 See ~~TABLE~~ for geologic sections

4 Log of holes D28u thru. D33u are on file in the Geology Section of Los Angeles District Office.

PLATE 5

PLAN

SCALE INTERPRET

400 800 1200 1600


Strike of vertical foliation.
Strike and dip (in degrees) of foliation.
Strike and dip (in degrees) of joint.
Strike of vertical joint.

DATUM IS MEAN SEA LEVEL

SYMBOL		DESCRIPTIONS	DATE	APPROVAL
		REVISIONS		

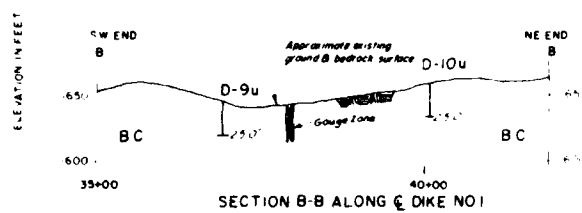
	U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS
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DRAWN BY: <i>G R O W</i> <i>R M H</i>	CAVE BUTTES DAM
CHECKED BY: <i>G R O W</i>	GENERAL SITE GEOLOGY AND PLAN OF GEOLOGIC EXPLORATION

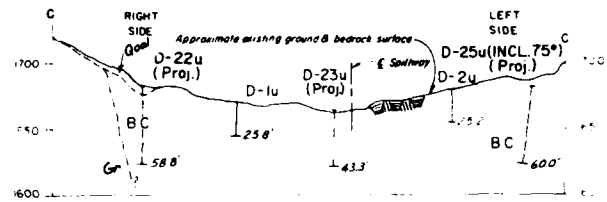
SUBMITTED BY:  OVER INSPECTION & SPECIAL SERVICES	SPEC. NO.	SHEET 5 OF 79
	DRAWING NUMBER DISTRICT FILE NO. 244/5	

FOUNDATION REPORT

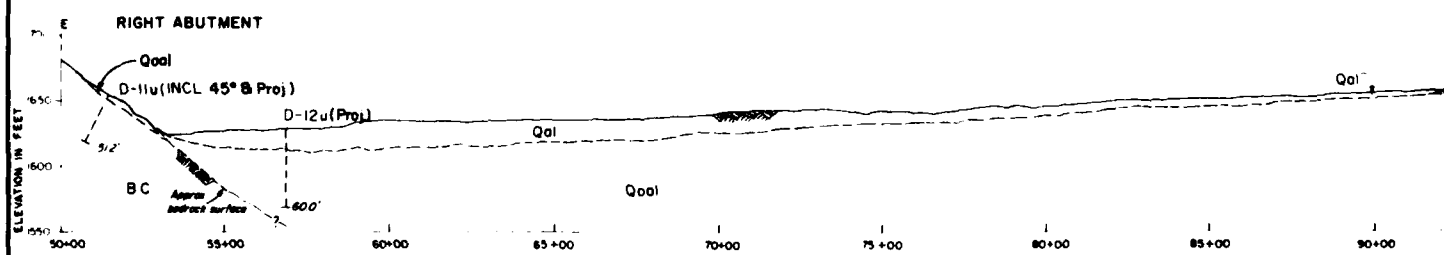
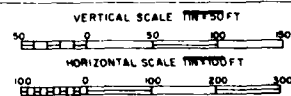
PLATE 4



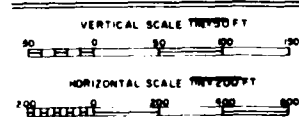
SECTION B-B ALONG C DIKE NO 1

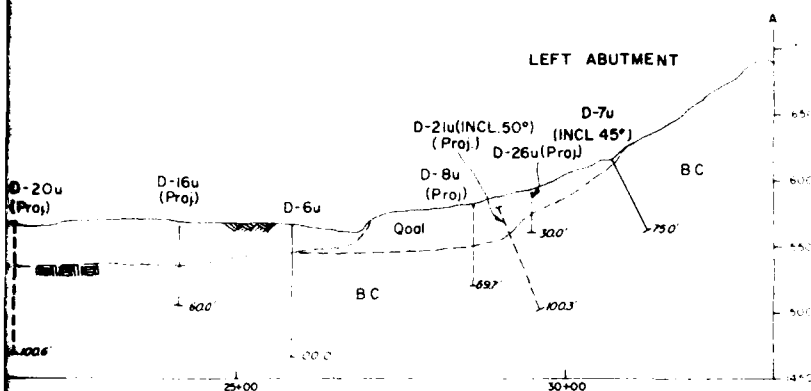


SECTION C-C ALONG CREST OF SPILLWAY



SECTION E-E ALONG G DIKE NO.2





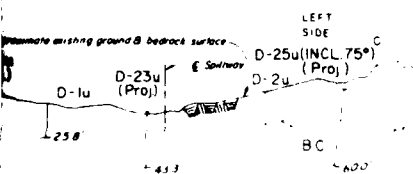
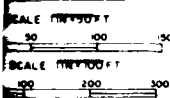
GENERAL NOTES

1. See SHEET 4 for legend and location of sections A-A through E-E.
2. See SHEETS 4 and 5 for geologic logs of diamond drill holes.
3. Diamond drill holes drilled for 1/2 size core.
4. Sections drawn looking upstream.
5. See SHEET 3 for location of section E-E.

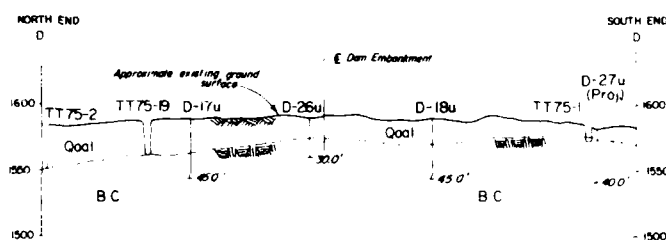
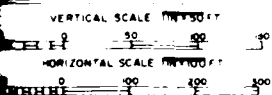
PLATES 6 AND 7

PLATE 8

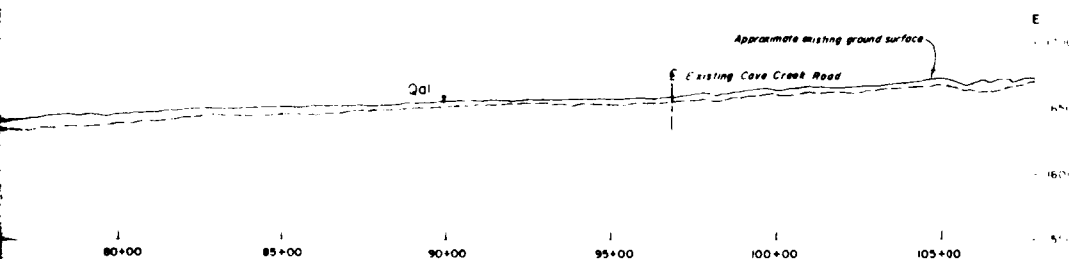
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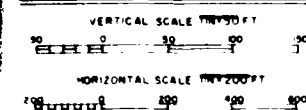
SECTION C-C ALONG CREST OF SPILLWAY



SECTION D-D ALONG OUTLET WORKS



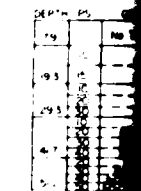
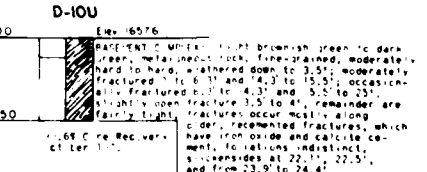
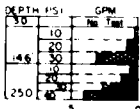
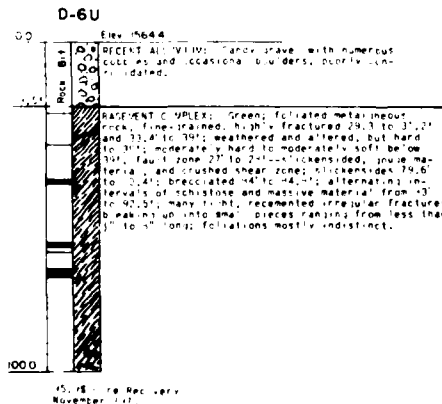
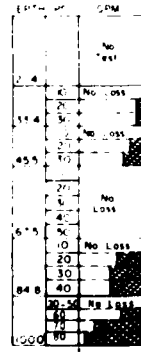
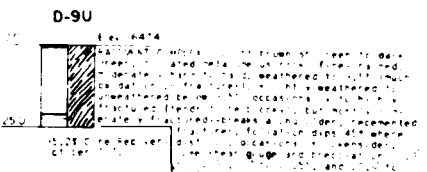
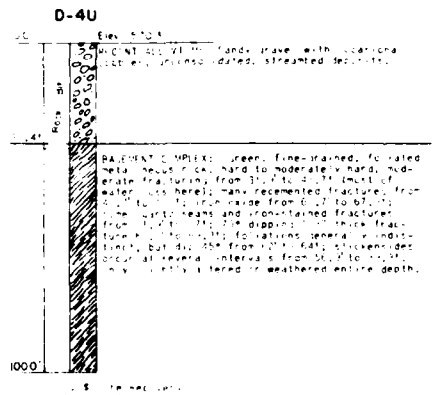
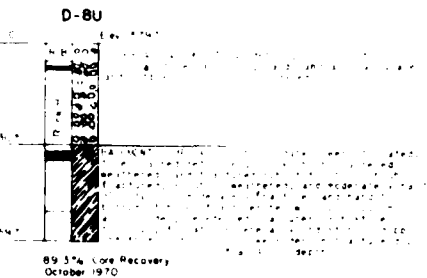
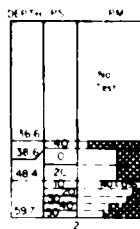
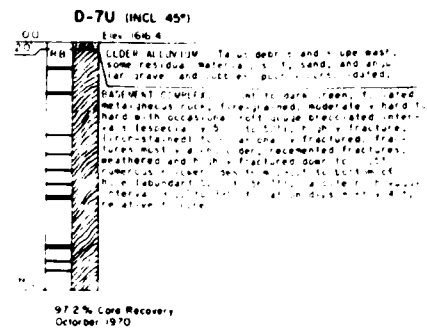
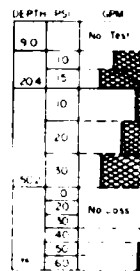
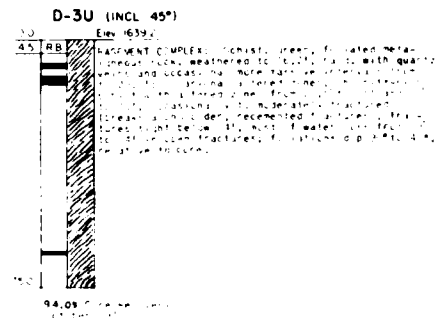
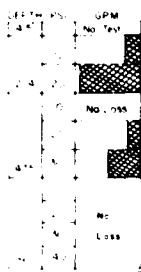
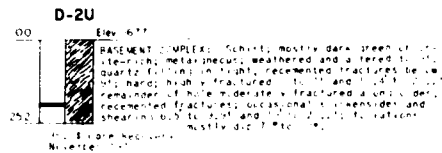
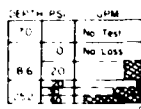
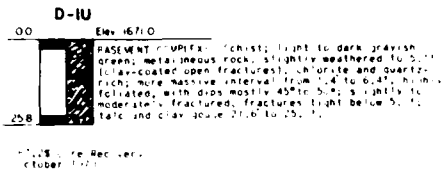
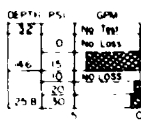
SECTION E-E ALONG DIKE NO. 2



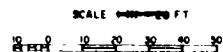
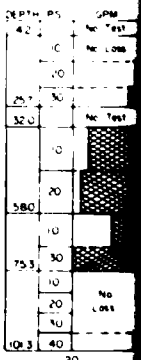
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REVISIONS			
U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS			
GULF RIVER BASIN NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA			
CAVE BUTTES DAM GEOLOGIC SECTIONS DAM, DIKES NO. 1 AND NO. 2, SPILLWAY, AND OUTLET WORKS			
DESIGNED BY: R.M.H.	DRAWN BY: J.W.H.		
CHECKED BY: G.G.	SUBMITTED BY: J.W.H.		
APPROVED BY: J.W.H.	SPEC. NO. BACKUP: J.J. 8-03J DISTRICT FILE NO. 244/6		

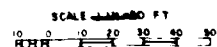
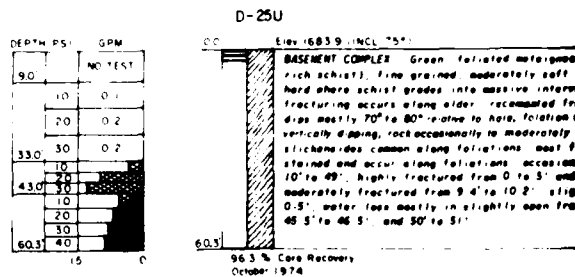
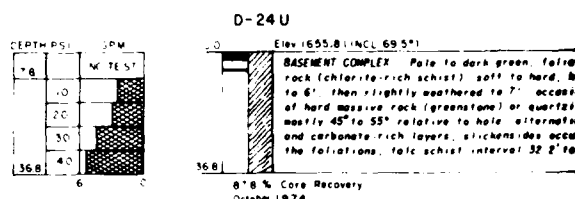
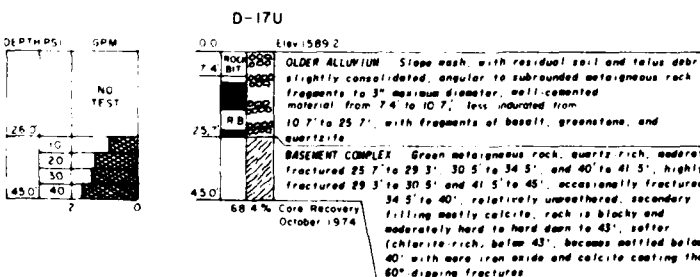
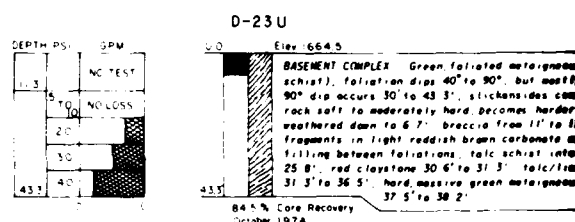
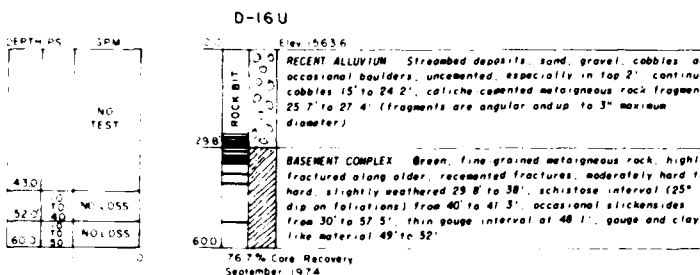
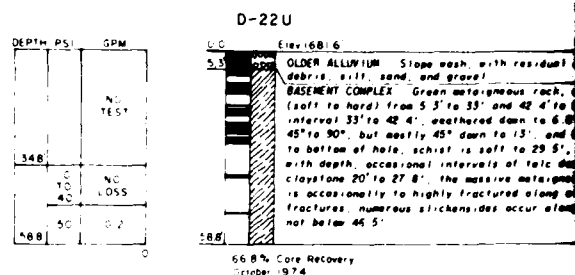
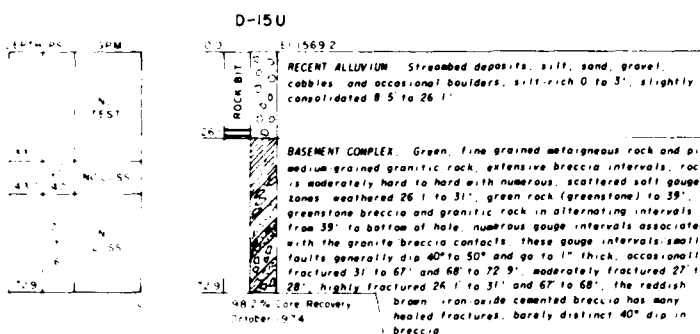
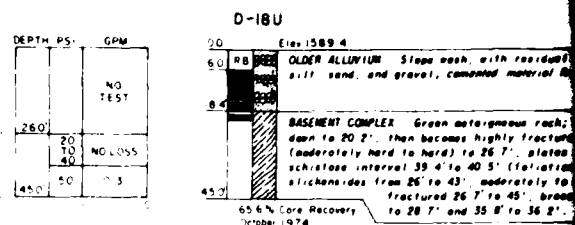
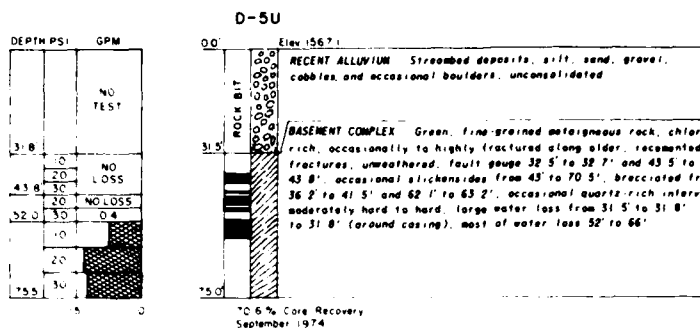
FOUNDATION REPORT

PLATE 8



No pressure test made
during test
on 10/10/70





D-18U

Elev 1589.4

OLDER ALLUVIUM Slope wash with residual soil and talus debris, silt, sand and gravel, cemented material from 6'0" to 18'4"

BASEMENT COMPLEX Green metaigneous rock, soft and weathered down to 20'2", then becomes highly fractured and slightly platy (moderately hard to hard) to 26'7", plates dip 35° at 24'5", schistose interval 39'4" to 40'5" (foliations dip 60°), occasional slickensides from 26' to 43' moderately to occasionally fractured 26'7" to 45', brecciated interval 28'3" to 28'7" and 35'8" to 36'2"

85.6% Core Recovery
October 1974

DEPTH PSI	GPM
180	NO TEST
20	0
20	0
300	0

D-22U

Elev 681.6

OLDER ALLUVIUM Slope wash, with residual soil and talus debris, silt, sand, and gravel.

BASEMENT COMPLEX Green metaigneous rock, chlorite rich schist (soft to hard) from 5'3" to 33' and 42'4" to 58'8", massive interval 33' to 42'4", weathered down to 6'8", foliation dips 45° to 90° but mostly 45° down to 13', and 60° to 70° from 13' to bottom of hole, schist is soft to 29'5", rock gets harder with depth, occasional intervals of talc down to 20' depth, claystone 20' to 27'8", the massive metaigneous rock (greenstone) is occasionally to highly fractured along older, recemented fractures, numerous slickensides occur along foliations, but not below 46'5"

66.8% Core Recovery
October 1974

DEPTH PSI	GPM
130	NO TEST
20	NO LOSS
20	0.1
30	0.3
400	40

D-23U

Elev 664.5

BASEMENT COMPLEX Green foliated metaigneous rock (chlorite rich schist), foliation dips 40° to 90° but mostly 45° to 60°, the 70° to 90° dip occurs 30' to 43'3", slickensides common along foliations, rock soft to moderately hard, becomes harder with depth, highly weathered down to 6'7", breccia from 11' to 13'—greenstone fragments in light reddish brown carbonate matrix, much iron oxide filling between foliations, talc schist interval from 23'4" to 25'8", red claystone 30'6" to 31'3", talc limonite rich schist 31'3" to 36'5", hard massive green metaigneous rock (greenstone) 37'5" to 38'2"

84.5% Core Recovery
October 1974

DEPTH PSI	GPM
43	NO TEST
20	NO LOSS
20	0.1
30	0.3
400	40

D-24U

Elev 655.8 (NCL 69.5%)

BASEMENT COMPLEX Pale to dark green, foliated metaigneous rock (chlorite rich schist) soft to hard, highly weathered to 6', then slightly weathered to 7', occasional intervals of hard massive rock (greenstone) or quartzite, foliation dips mostly 45° to 55° relative to hole, alternating chlorite rich and carbonate rich layers, slickensides occur occasionally along the foliations, talc schist interval 32'2" to 32'8"

87.8% Core Recovery
October 1974

DEPTH PSI	GPM
36	NO TEST
20	NO LOSS
20	0.1
30	0.2
40	0.2
400	40

D-25U

Elev 1683.9 (NCL 75%)

BASEMENT COMPLEX Green, foliated metaigneous rock (chlorite rich schist), fine grained, moderately soft to moderately hard, hard where schist grades into massive interval (greenstone), fracturing occurs along older, recemented fractures, foliation dips mostly 70° to 80° relative to hole, foliation of ground surface is vertically dipping, rock occasionally to moderately fractured, slickensides common along foliations, most fractures are iron cemented and occur along foliations, occasional slickensides from 10' to 49', highly fractured from 0' to 5' and 12' to 13'2", moderately fractured from 8'4" to 10'2", slightly weathered, 0.5" water loss mostly in slightly open fractures from 34' to 38', 48'5" to 46'5", and 50' to 51'

98.3% Core Recovery
October 1974

DEPTH PSI	GPM
60	NO TEST
0.1	
0.2	
0.2	
400	40

D-26U

Elev 1590.2

OLDER ALLUVIUM Slope wash residual soil and talus debris, cemented material from 5' to 8' depth, cobbles encountered 11' to 15'5"

BASEMENT COMPLEX Green, non-foliated metaigneous rock, occasionally to highly fractured along older, recemented fractures, very soft to hard, numerous slickensides from 21'5" to 27', occasionally to moderately fractured from 15'5" to 20' and 26'8" to 30', gouge interval 23'7" to 24', coarser grained 27' to 30', fractures coated with iron oxide, highly weathered 15'5" to 17'8"

84.1% Core Recovery
October 1974

D-27U

Elev 1580.9

OLDER ALLUVIUM Slope wash residual soil and talus debris, cemented material from 5'5" to 7'0"

BASEMENT COMPLEX Green metaigneous rock, moderately soft to hard, occasionally to highly fractured along older, recemented fractures, slightly weathered 7' to 8'5", epidote rich and platy (moderately soft) 12'8" to 14'8", banded hard metaigneous rock (greenstone) 14'8" to 34', foliated from 14' to 40', foliations dip mostly 45°, occasional slickensides from 11' to 34', usually along foliations, occasional gouge intervals, highly fractured 20'1" to 22'5", 25'7" to 27'6", and 35'2" to 36', occasionally fractured from 22'5" to 25'7", and 36' to 40', moderately fractured 7' to 20'1" and 27'6" to 35'2", platy schistose intervals from 28'4" to 29'6" and 30'4" to 35'2"

82.5% Core Recovery
October 1974

TT.75-1

Elev 577.6

OLDER ALLUVIUM Slope wash and residual material, silt, sand and gravel, some caliche between 1'5" to 4'5", thin lenses of cemented materials from 4'5" to 7'5" and below 7'5" coarse unconsolidated materials including some cobbles and occasional boulders 2'5" maximum diameter

BASEMENT COMPLEX Green, platy schist, cryptocrystalline, moderately hard to hard, foliations dip 60° to 85°

July 1975

TT.75-2

Elev 581.4

OLDER ALLUVIUM Slope wash and residual material, silt, sand and gravel, unconsolidated, some lenses of well cemented material from 3'0" to 9'0", loosely consolidated coarse material below 9'0", some cobbles and occasional boulders 2' maximum diameter

BASEMENT COMPLEX Green, platy schist, cryptocrystalline, moderately hard to hard, foliations dip 50° to 70°

July 1975

TT.75-9

Elev 587.6

OLDER ALLUVIUM Slope wash and residual material, silt, sand and gravel, unconsolidated, well cemented material from 5'0" to 13'0", loosely consolidated coarse material below 13'0" including cobbles and occasional boulders 2' maximum diameter

BASEMENT COMPLEX Green, platy schist, cryptocrystalline, moderately hard to hard, foliations dip 60° to 85°

August 1975

GENERAL NOTES

- SEE SHEETS FOR LEGEND PLATE 4
- SEE SHEETS FOR PLAN OF EXPLORATION SHOWING LOCATION OF DIAMOND DRILL HOLES AND GEOLOGY PLATE 3
- DRILL HOLE INCLINATIONS ARE MEASURED FROM HORIZONTAL
- SOIL CLASSIFICATIONS ON THIS SHEET ARE VISUAL
- DIP OF FOLIATIONS AND JOINTS, FRACTURES, AND FAULTS MEASURED FROM HORIZONTAL (EXCEPT IN INCLINED HOLES WHERE IT IS MEASURED RELATIVE TO CORE)
- TERM "GREENSTONE" REPRESENTS THE GREEN, MASSIVE METAIGNEOUS ROCK

DATUM IS MEAN SEA LEVEL

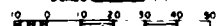
SPECIFIC		REVISIONS		DATE		APPROVAL	
U.S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS							
GILA RIVER BASIN NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA CAVE BUTTES DAM GEOLOGIC LOGS—SHEET II							
DESIGNED BY R.M.H.	CHECKED BY J.Y.	SPECIAL AGENT DISTRICT FILE NO. 244/8					

FOUNDATION REPORT

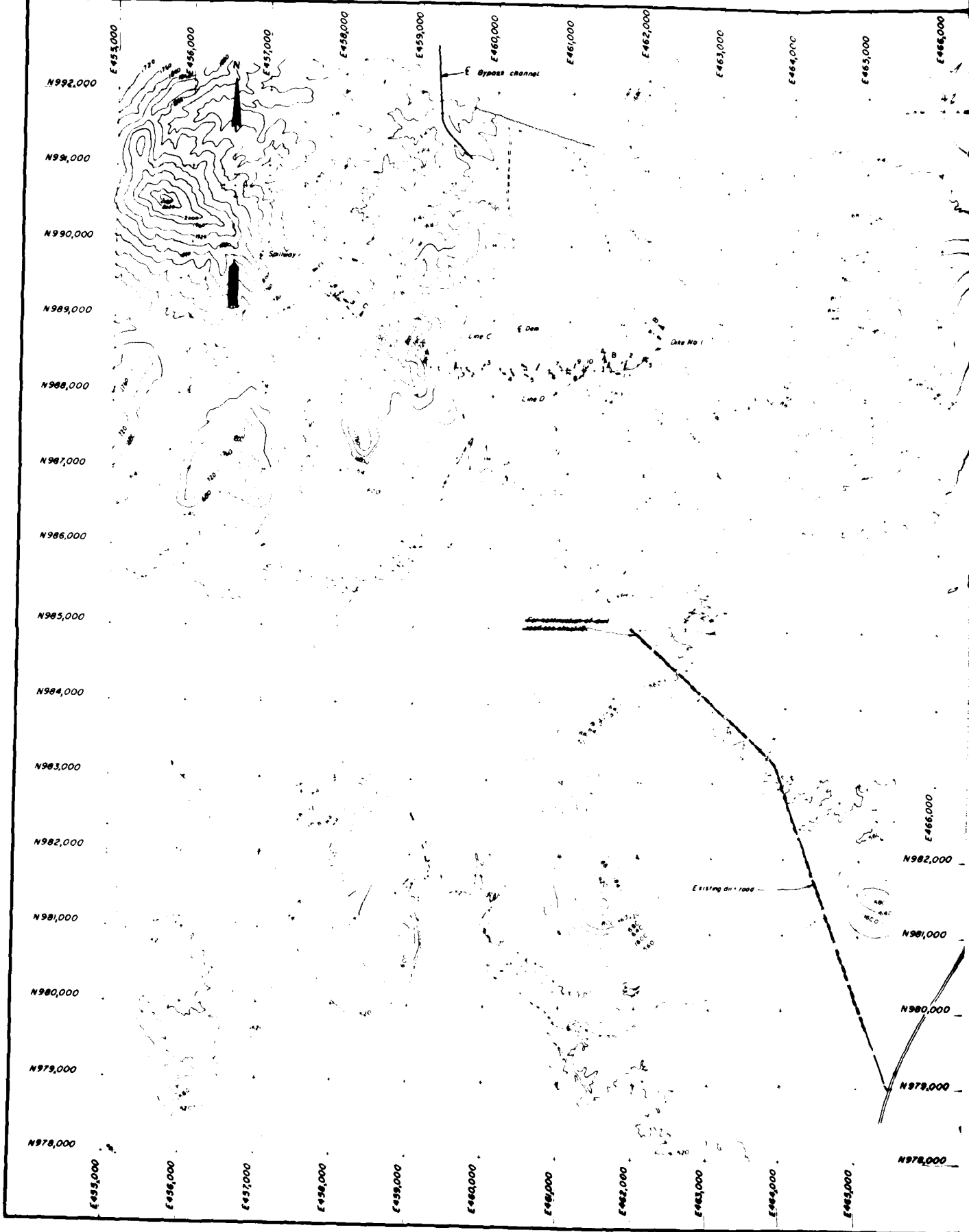
PLATE 7

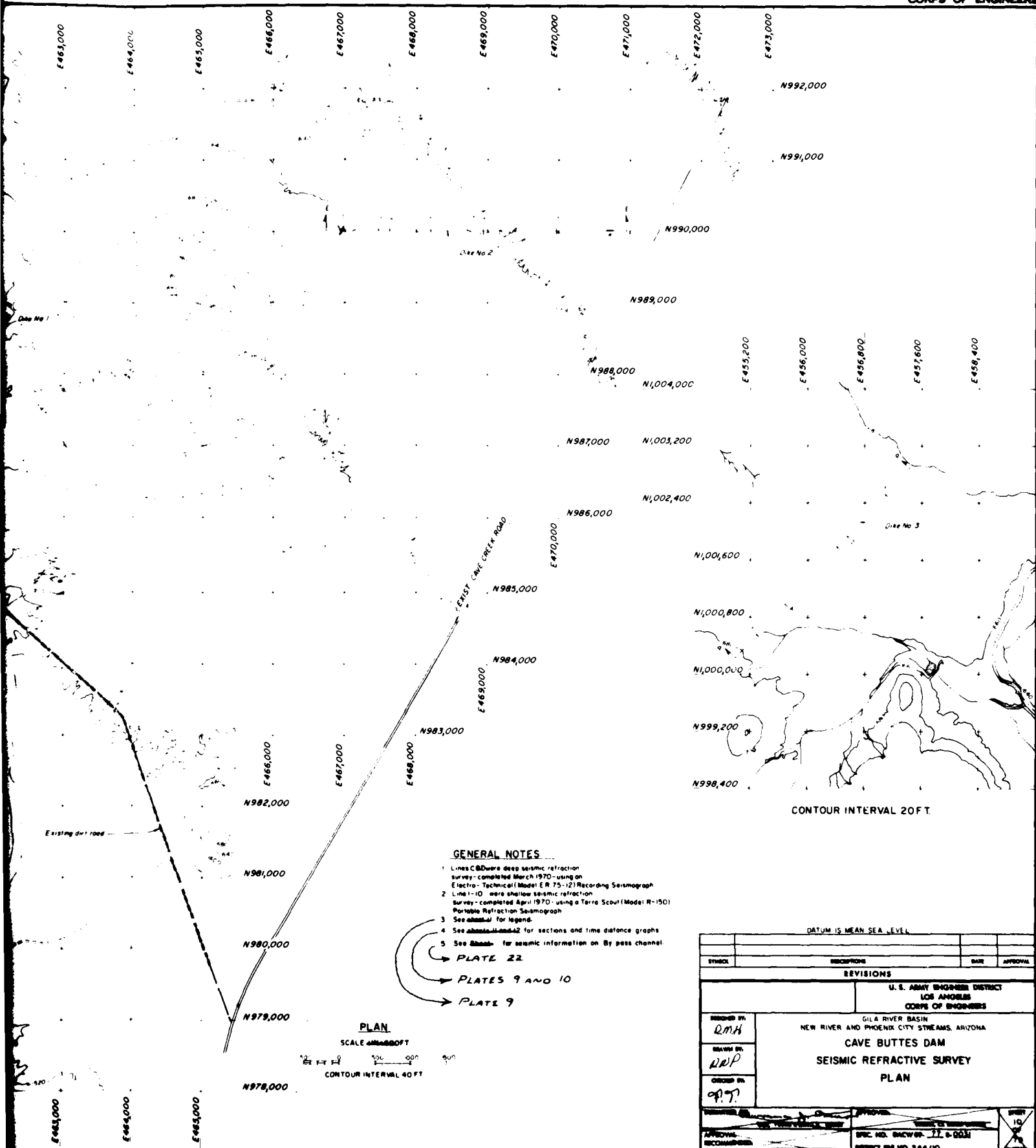
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SCALE 1"=100 FT

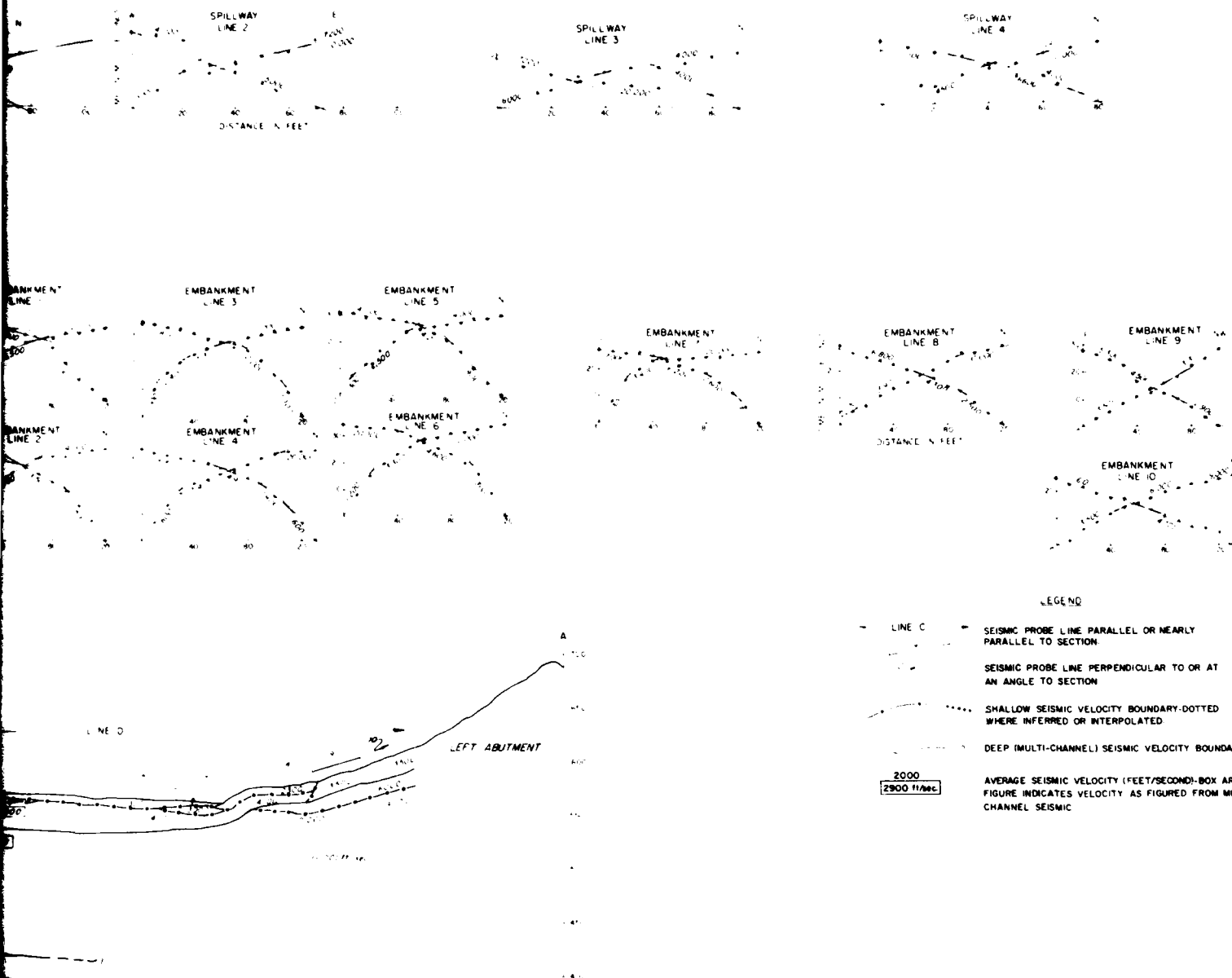


U.S. ARMY ENGINEER DISTRICT





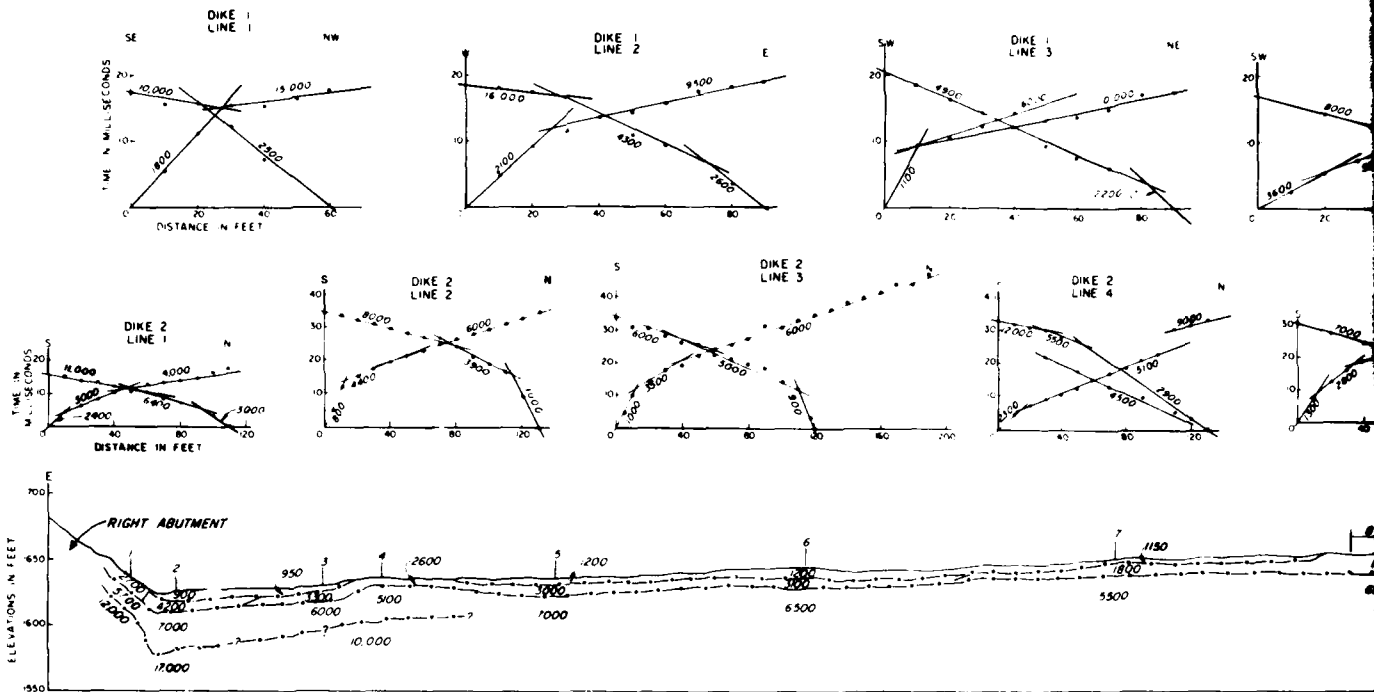
1. SEE SHEET 40 FOR L
2. NUMBERED LINES A
REFRACTION SEISMO
LABORATORIES. PHE
3. LINES C AND D ARE
MODEL ERT5-12 RE
BY HEINRICHS GEO
4. TIME-DISTANCE GR



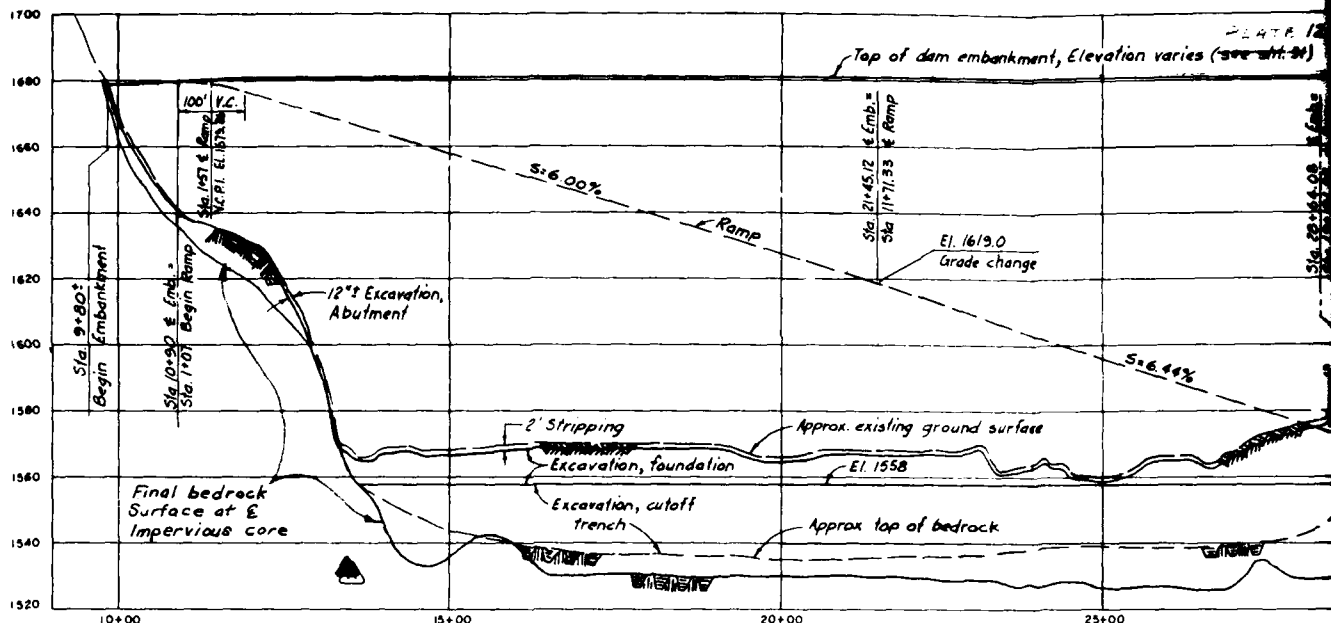
GENERAL NOTES

- SEE SHEET 8 FOR LOCATION OF SEISMIC PROBE LINES PLATE 8.
- NUMBERED LINES ARE SHALLOW SEISMIC PROBES DONE WITH A TERRASCOUT PORTABLE REFRACTION SEISMOGRAPH DURING APRIL 1970. WORK WAS DONE BY ARIZONA TESTING LABORATORIES, PHOENIX, ARIZONA.
- LINES C AND D ARE DEEP SEISMIC (MULTI-CHANNEL) DONE WITH AN ELECTRO-TECHNICAL MODEL ER75-12 RECORDING SEISMOGRAPH DURING 17-18 MARCH 1970. WORK WAS DONE BY HEINRICHS GEOEXPLORATION COMPANY, TUSCON, ARIZONA.
- TIME-DISTANCE GRAPHS FROM CONTRACTORS RECORDS

DESIGNED BY		U S ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS	
DRAWN BY		GILA RIVER BASIN NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA	
CHECKED BY		CAVE BUTTES DAM	
APPROVED BY		SEISMIC REFRACTIVE SURVEY	
RECOMMENDED BY		SECTIONS AND TIME-DISTANCE GRAPHS	
DATE		SHEET 11	
SPEC NO. DACW 09-77-8-0931		75	
DISTRICT FILE NO. 244/11		SHEET	



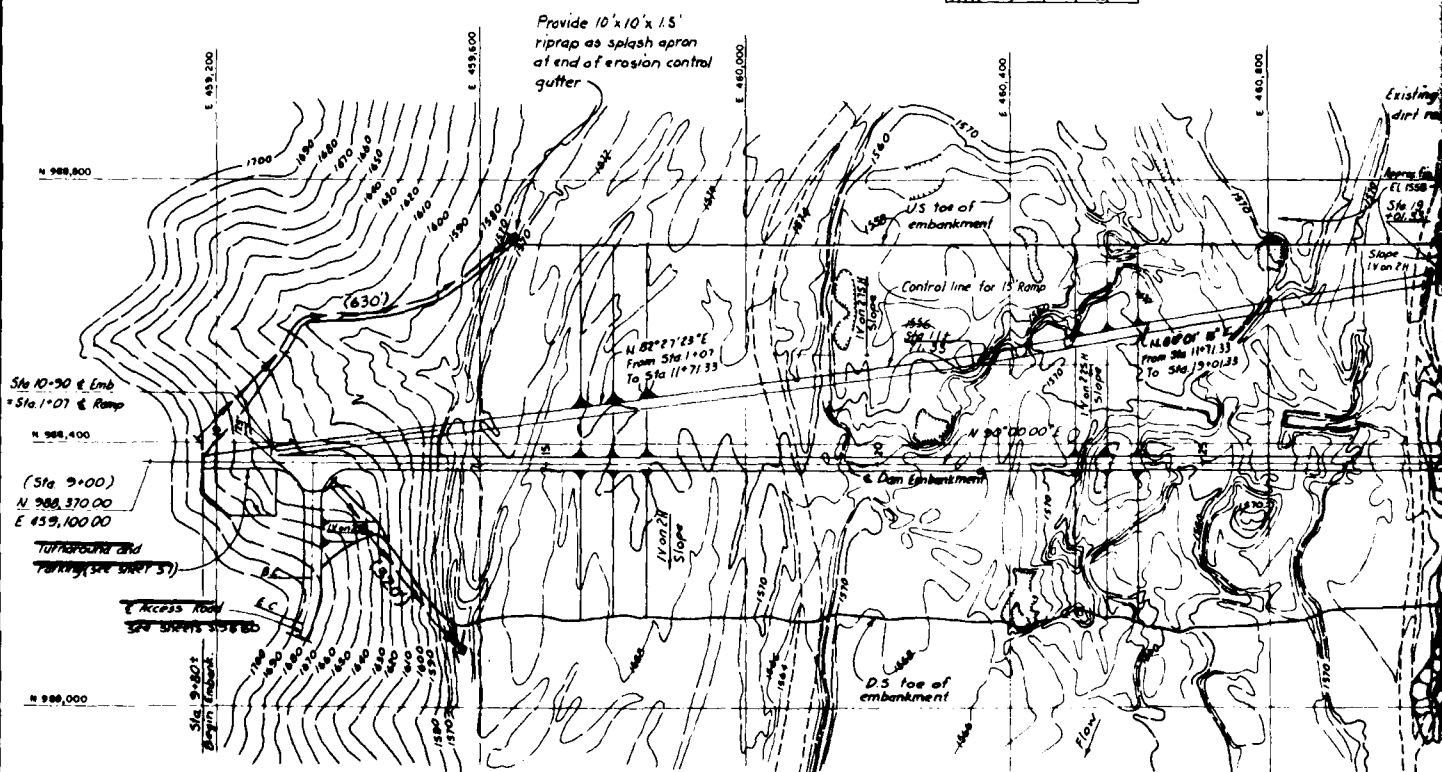
Top of dam embankment, Elevation varies (see att. 34)








6. PROFILE

HORIZONTAL SCALE 1"=100 FT
100 0 100 200

VERTICAL SCALE 1"=20 FT
10 0 10 20 30 40 50



LEGEND

-  Existing contour lines, with elevations shown.
 Location of erosion control gutter, with horizontal length indicated, see page 35 for details.
 Provide 10' x 10' x 1.5' riprap as splash apron at end of erosion control gutter.
 Approximate existing ground surface
 Approximate bedrock surface

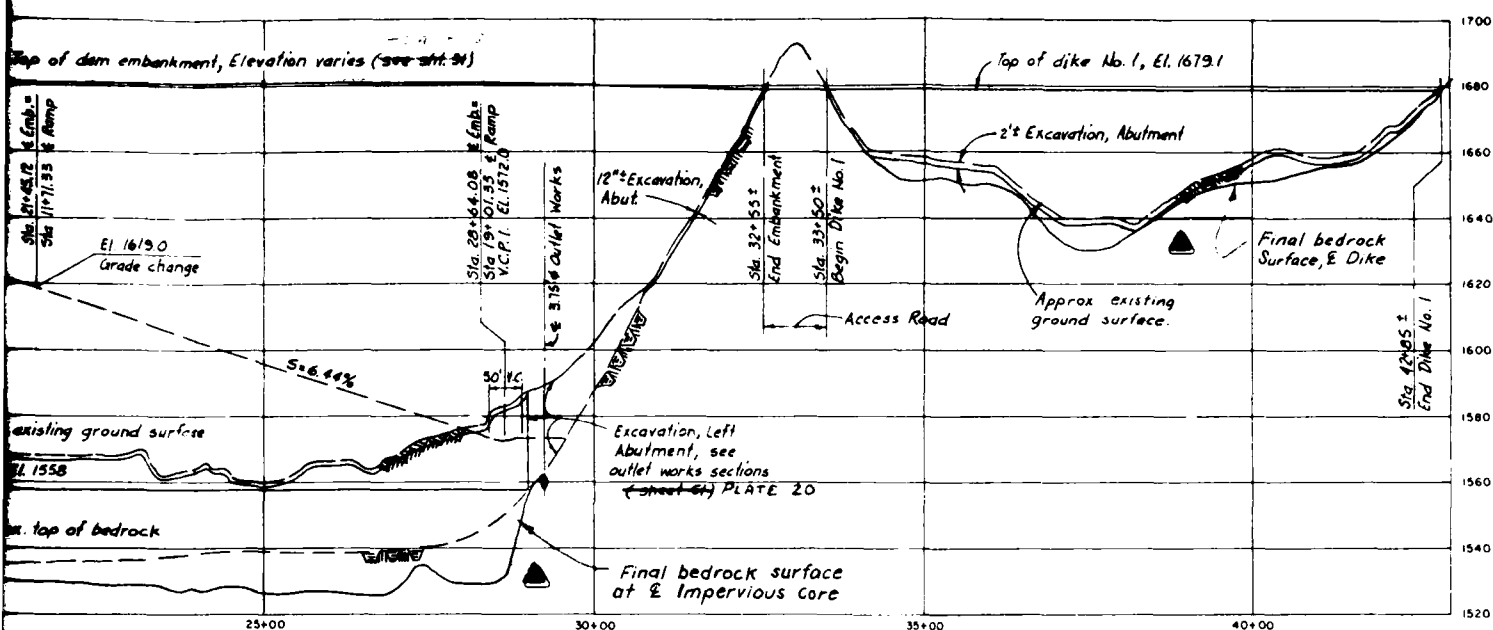
REFERENCE DRAWINGS

1. For cross sections, see sheets 88-90
2. For instrumentation, see sheets 88-90
3. For foundation, abutments and trench excavation, see sheet 88
4. For Access Road, see sheet 88
5. For Outlet Works, Plan & Profile, sheets 88-90. PLATE 19.
6. For earthfill treatment of embankment see sheets 10-10.

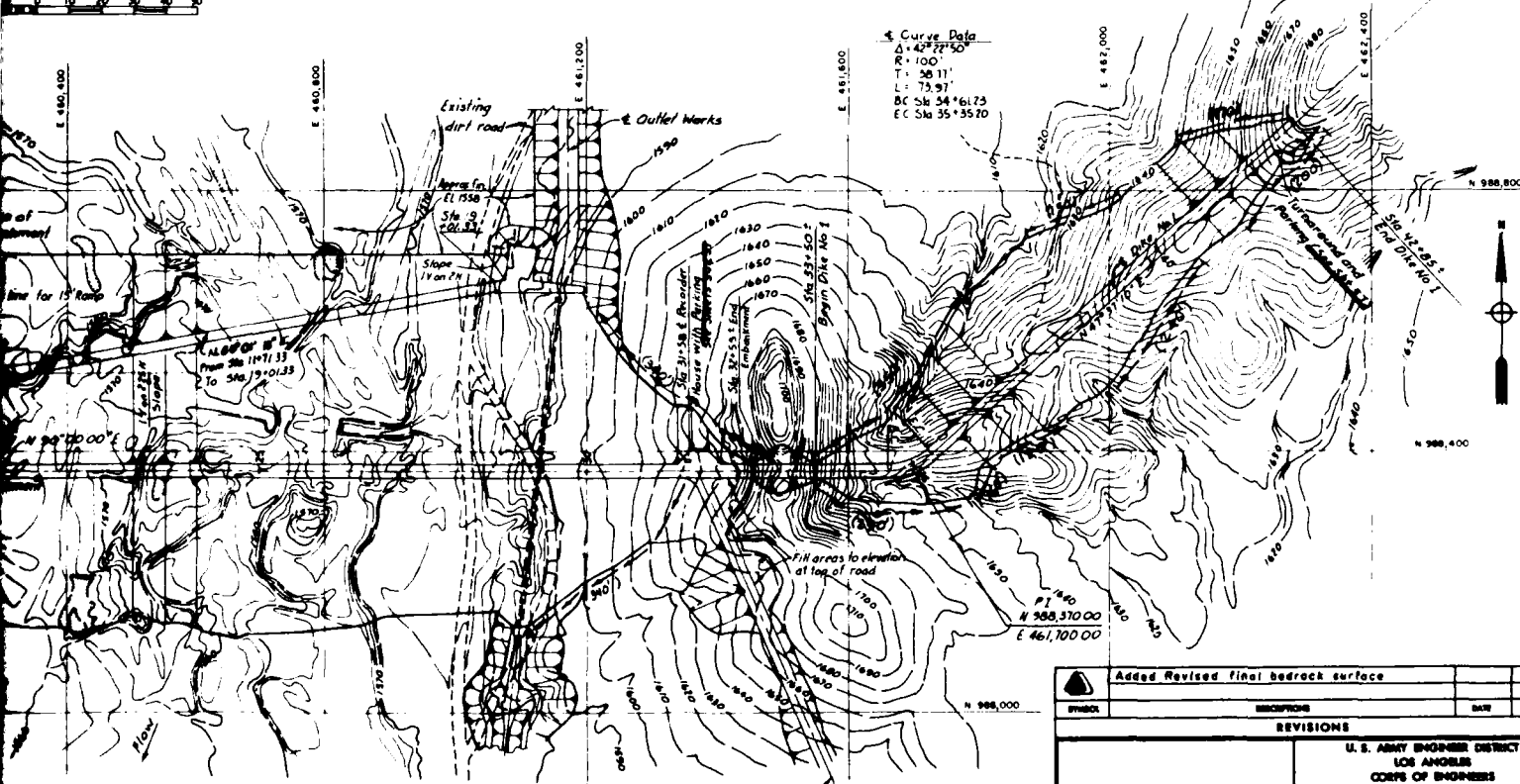
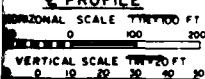
PLAN

SCALE ~~1 IN = 100~~ FT





PROFILE



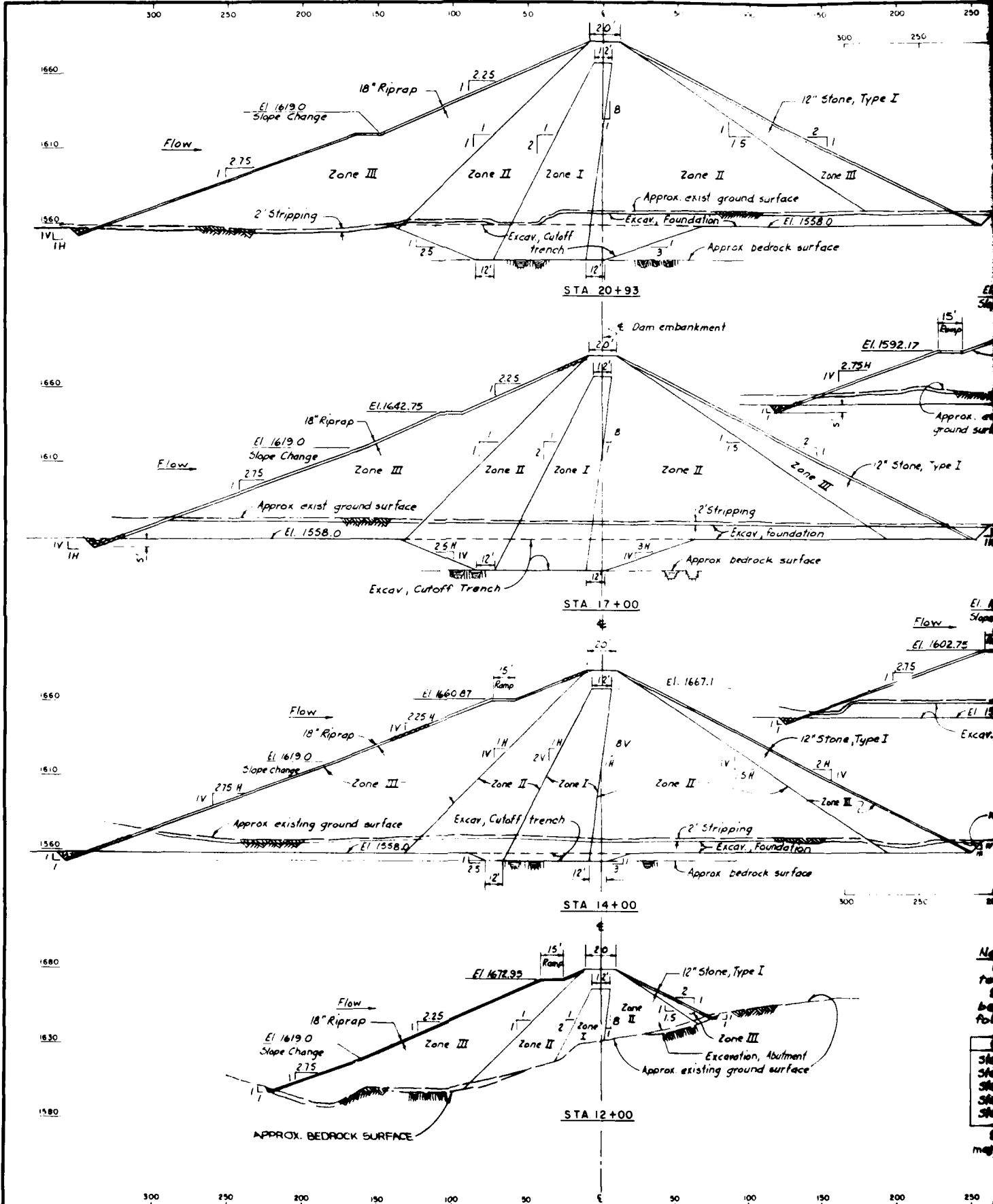
REFERENCE DRAWINGS

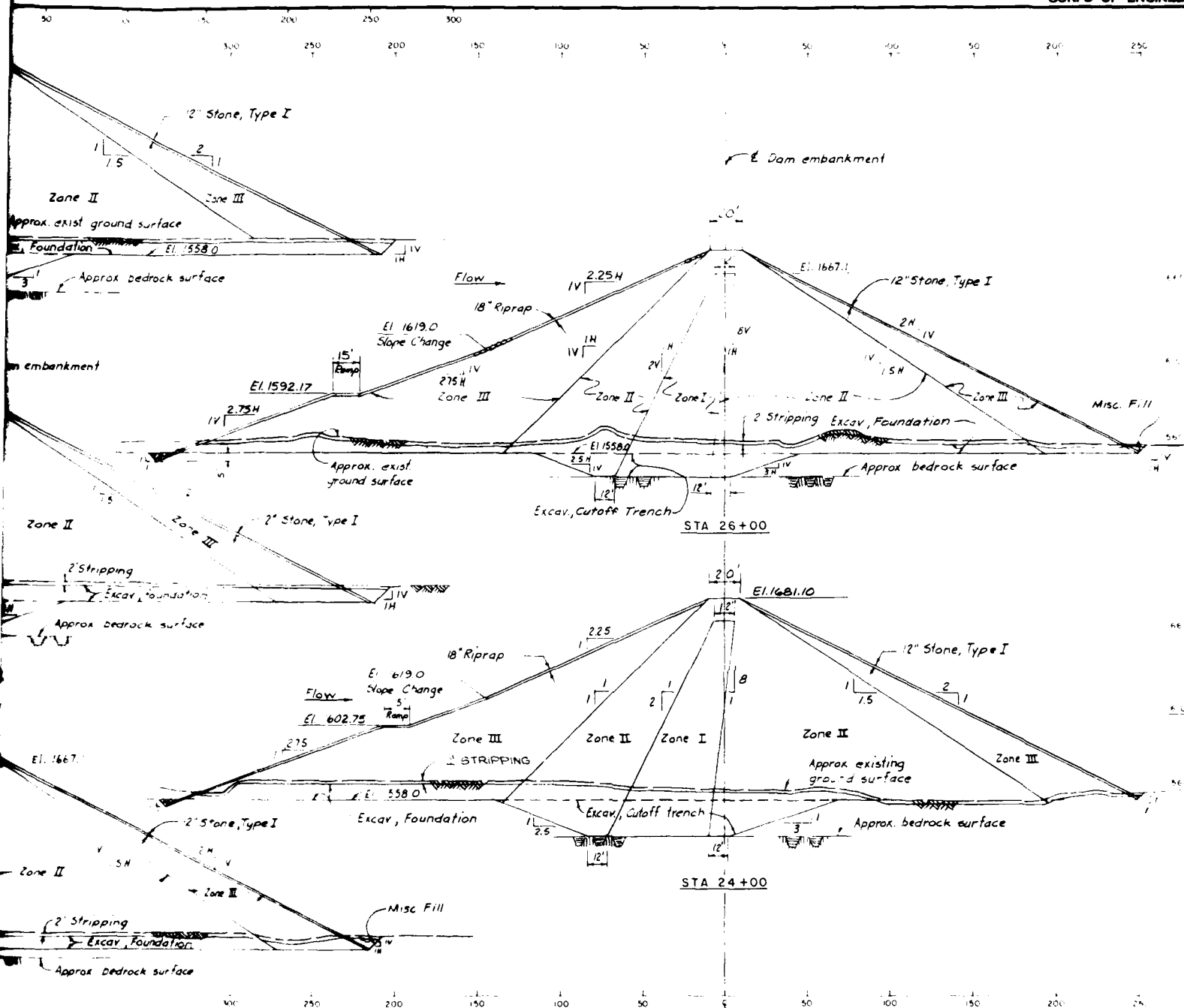
1. For cross sections, see sheets 12 and 13
2. For instrumentation, see sheets 14 and 15
3. For foundation, abutments and cutoff trench excavation, see sheet 16
4. For Access Road, see sheet 17
5. For Outlet Works, Plan & Profile, see sheet 18
6. For esthetic treatment of embankment, see sheet 19

REFERENCES

1. TOPOGRAPHY BY PHOTOGRAMMETRIC METHOD BY AERIAL MAPPING CO SURVEY OF OCTOBER 1974 CONTOUR INTERVAL AS SHOWN.
2. HORIZONTAL CONTROL IS BASED ON NATIONAL GEODETIC SURVEY DATUM. VERTICAL CONTROL IS BASED ON 1929 MSL DATUM.

Added Revised final bedrock surface		DATE	APPROVAL
REVISIONS U.S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS GILA RIVER BASIN NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA CAVE BUTTES DAM DAM AND DIKE NO. 1 EMBANKMENTS PLAN AND PROFILE			
DESIGNED BY J.M.H.	CHECKED BY J.W.S.	APPROVED BY [Signature]	
DRAWN BY J.W.S.		APPROVED BY [Signature]	
CHECKED BY [Signature]		APPROVED BY [Signature]	
APPROVAL [Signature]		SPEC. NO. DACW 69-77-2-2221 DISTRICT FILE NO. 244/30	



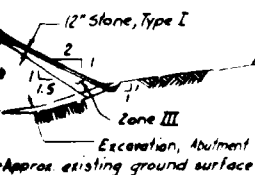


Notes

1. For typical section, details of crown, toe, erosion control gutter, and ramp, see ~~Sheet 32~~ ^{PLATE 13}.
2. Crest elevation of dam shall vary uniformly between stations in accordance with the following table:

CREST ELEVATION, DAM	
Sta. 9+80	El. 1679.10
Sta. 12+00	El. 1680.10
Sta. 14+00	El. 1681.10
Sta. 26+00	El. 1681.10
Sta. 32+55	El. 1679.10

3. Downstream Zone III material above El. 1657 may be replaced with Zone II material.

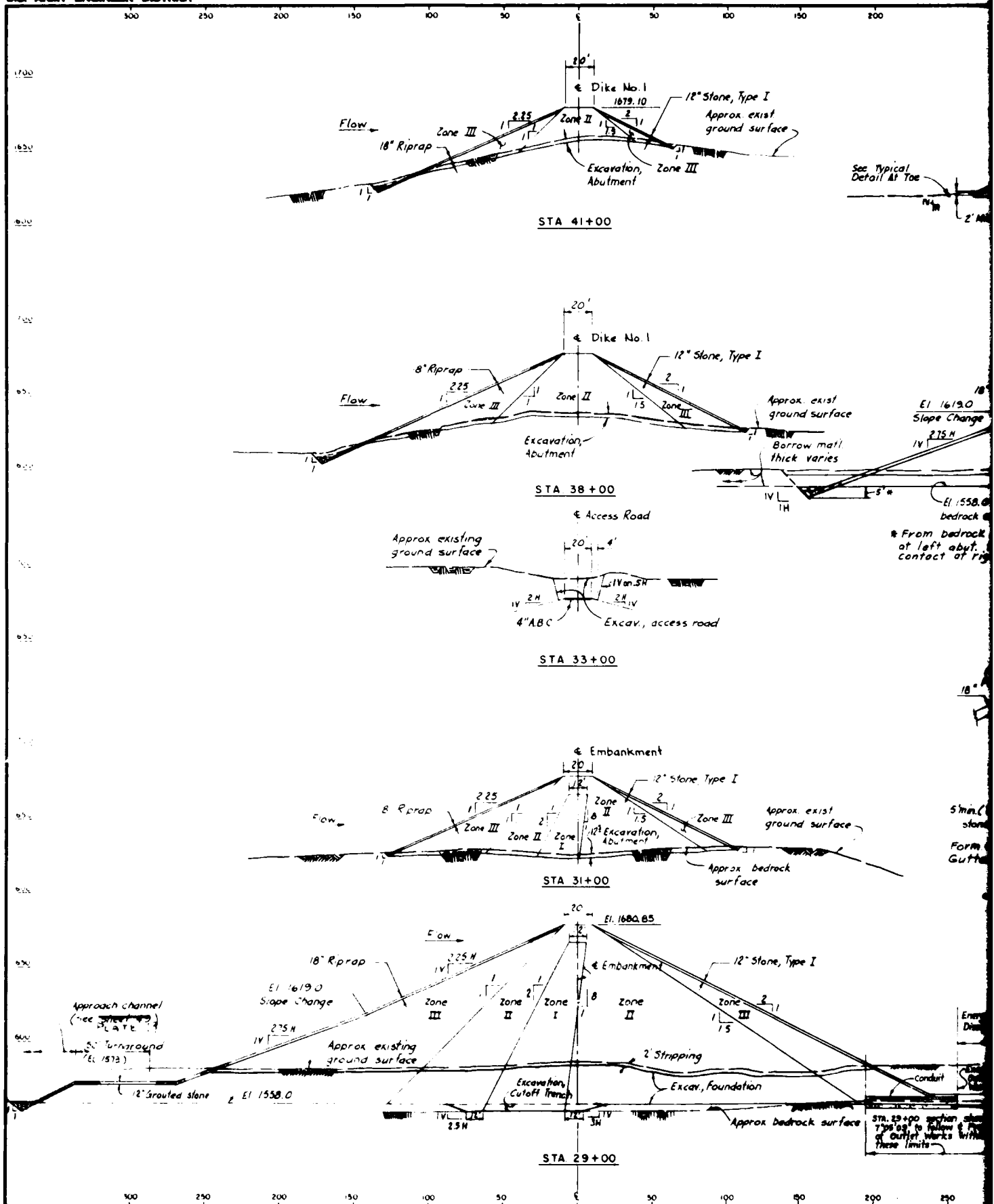


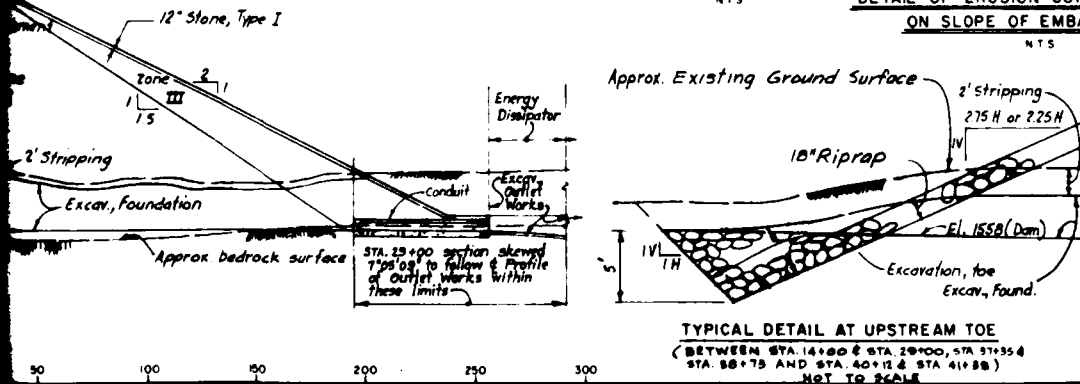
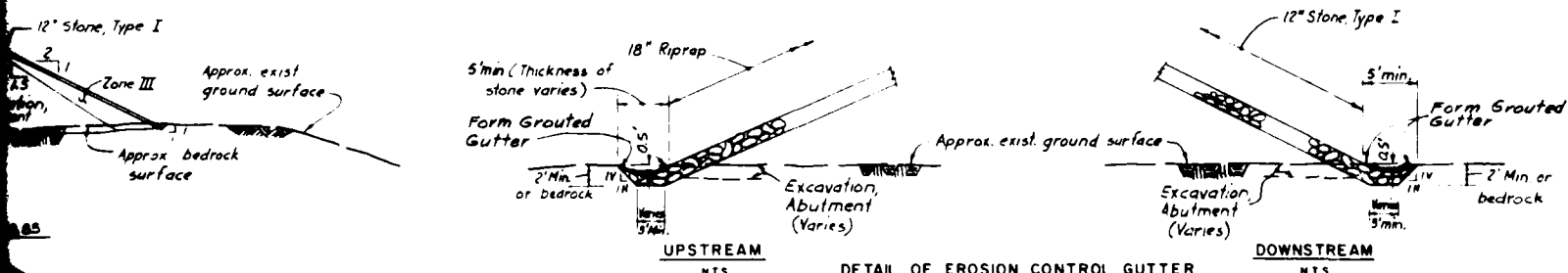
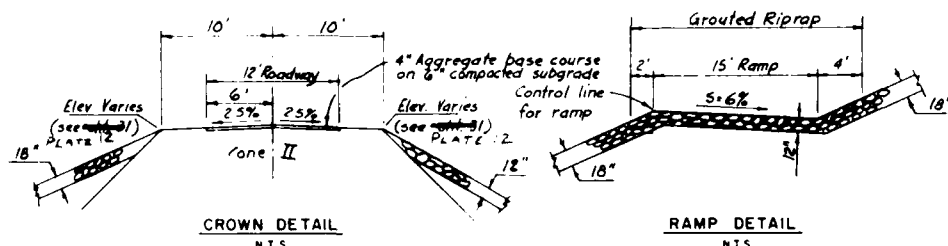
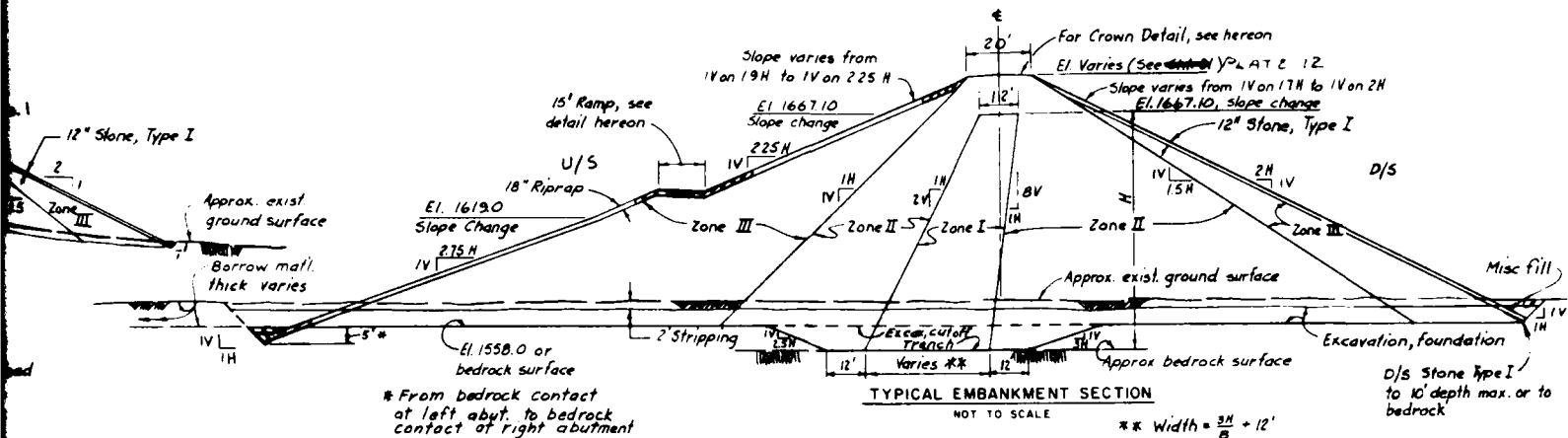
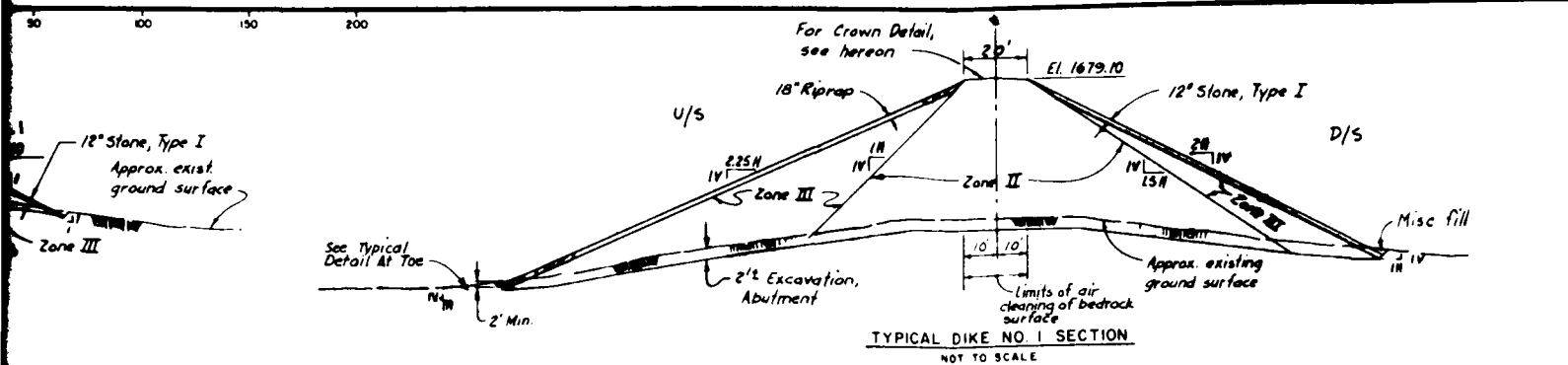
DATUM IS MEAN SEA LEVEL			
ETHICAL	DESCRIPTION	DATE	APPROVAL
REVISIONS			
U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS			
GILA RIVER BASIN NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA			
CAVE BUTTES DAM			
DAM AND DIKE NO. 1 EMBANKMENTS CROSS SECTIONS SHEET I			
DESIGNED BY: <i>J. H. H.</i>	DRAWN BY: <i>YWS</i> <i>BEV</i>		
CHECKED BY: <i>J. H. H.</i>	APPROVED BY: <i>J. H. H.</i>		
SPEC. NO. DAWOP. 22-B-5531		DISTRICT FILE NO. 244/31	

FOUNDATION REPORT

PLATE 13

2



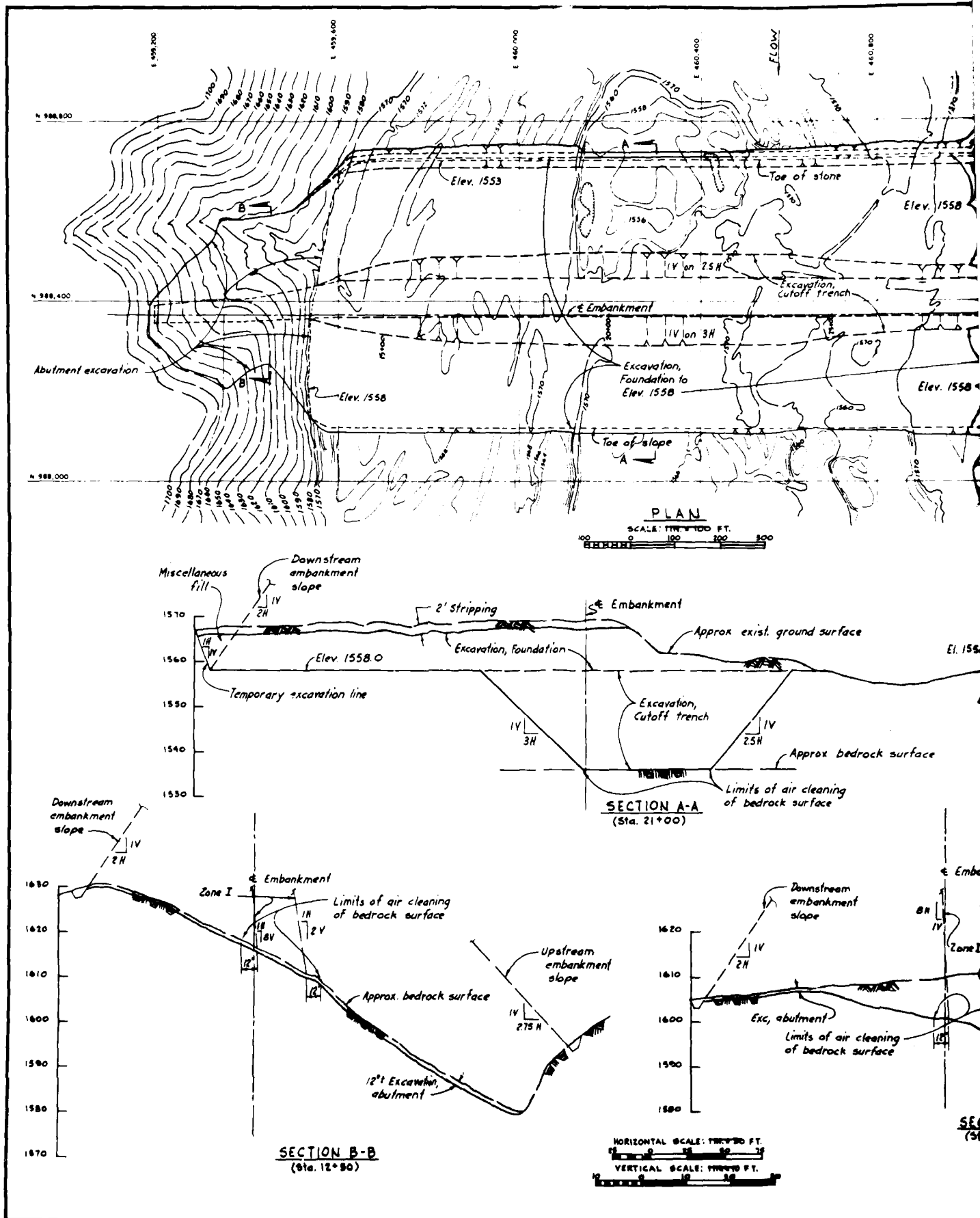


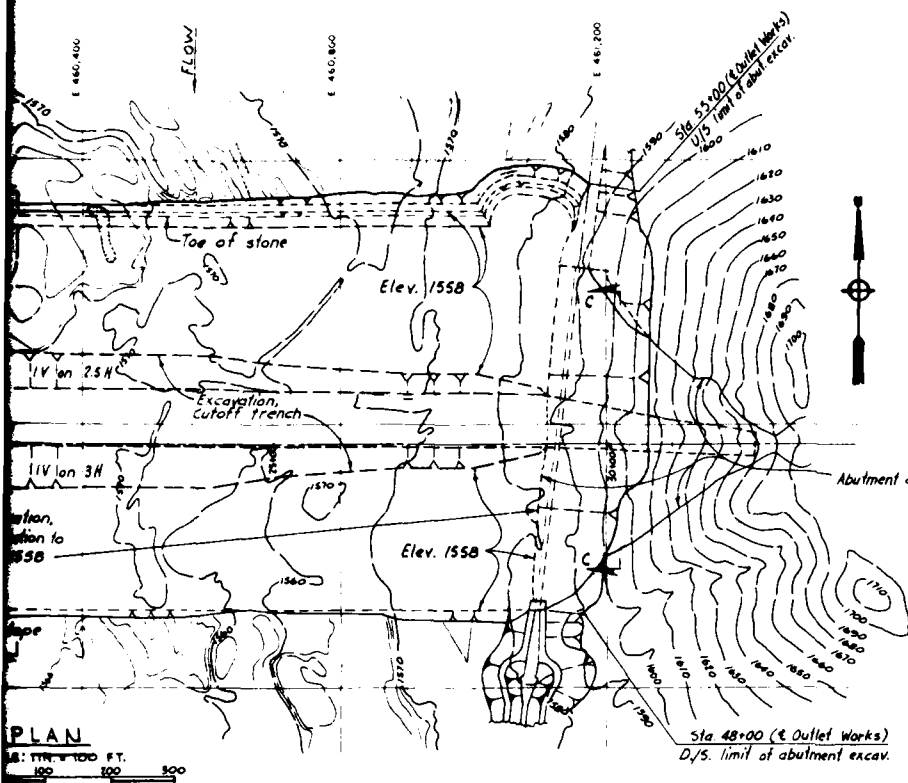
REVISIONS			
NO.	DESCRIPTION	DATE	APPROVED
U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS			
GILA RIVER BASIN NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA			
CAVE BUTTES DAM			
DAM AND DIKE NO. 1 EMBANKMENTS			
CROSS SECTIONS SHEET II			
DESIGNED BY	JOHN H. HARRIS	CHECKED BY	W. S. WILSON
DRAWN BY	W. S. WILSON	APPROVED BY	JOHN H. HARRIS
DATE	1954	DATE	1954
SPEC. NO. DACW 07-22-6-0031		DISTRICT FILE NO. 244/32	

FOUNDATION REPORT

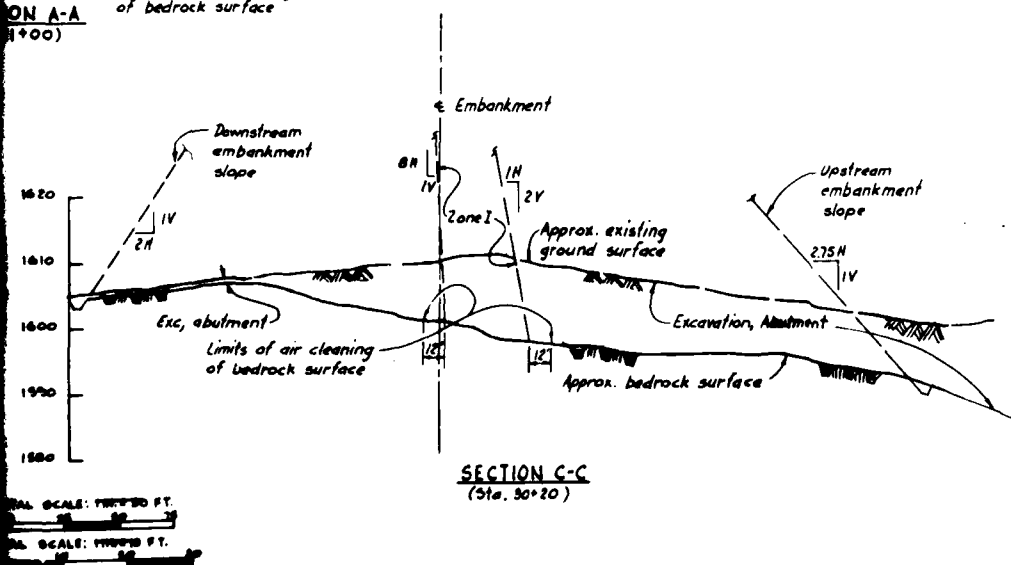
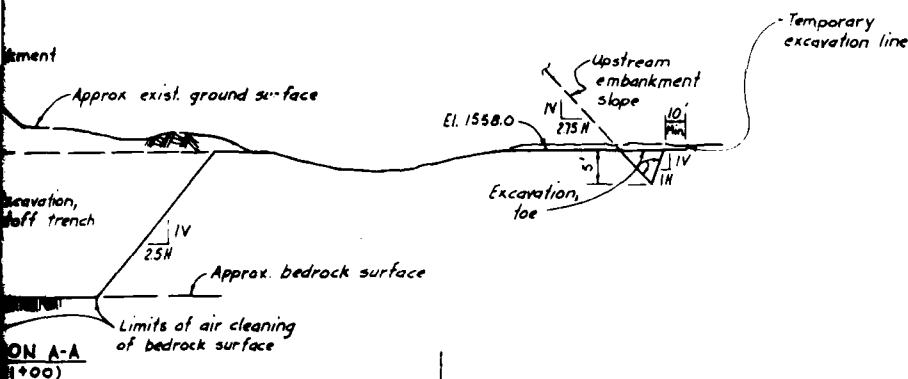
PAGE 13

2





Note:
For details of outlet works excavation, see sheets 49-50
PLATES 9, 20 AND 21



REFERENCES.

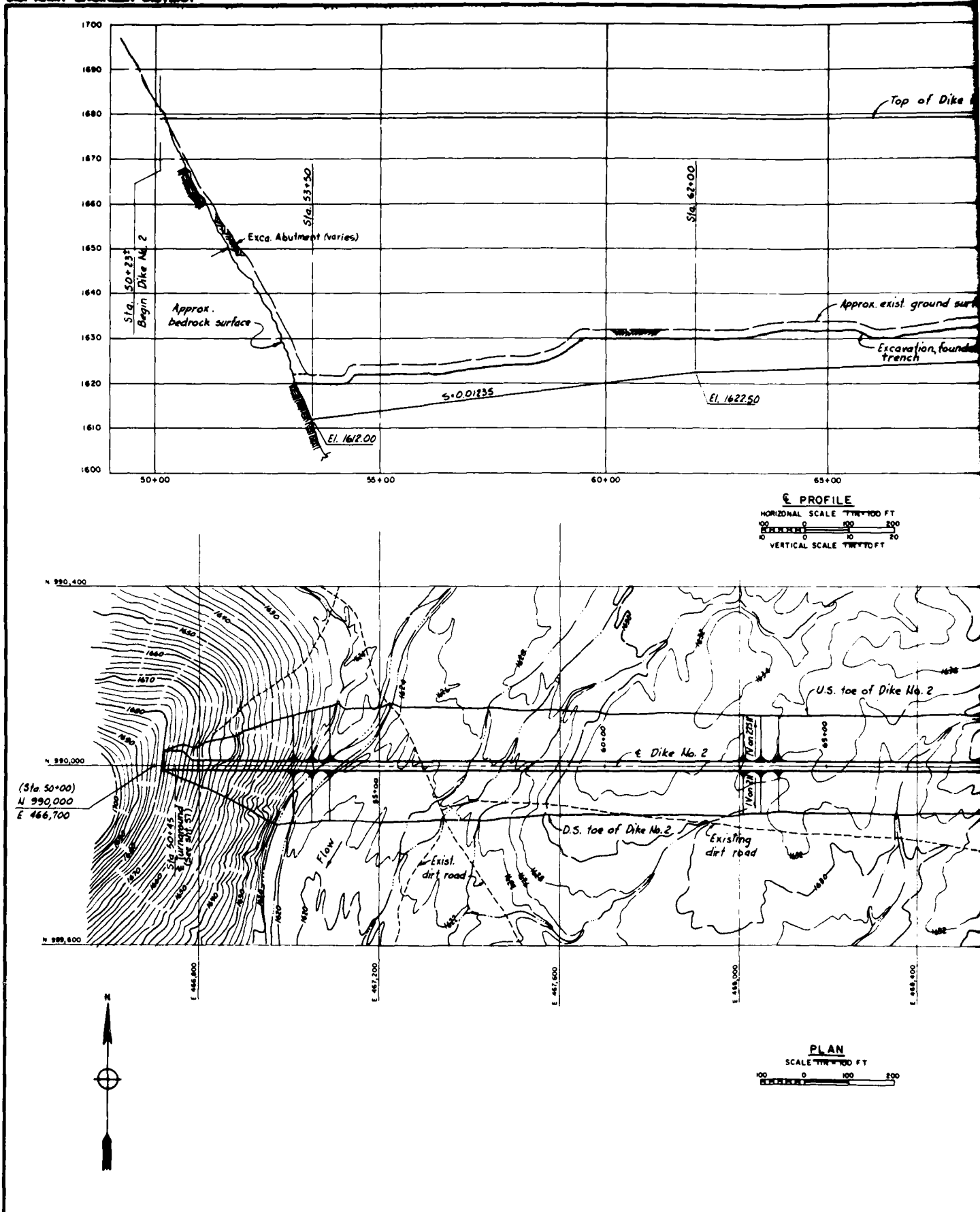
1. Topography by photogrammetric method by Aerial Mapping Co. Survey of October 1974. Contour interval as shown.
2. Horizontal control is based on National Geodetic Survey Datum. Vertical is based on 1929 MSL Datum.

SYMBOL	DESCRIPTION	DATE	APPROVAL
REVISIONS			
U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS			
GILA RIVER BASIN NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA CAVE BUTTES DAM DAM EMBANKMENT-FOUNDATION, ABUTMENTS AND CUT OFF TRENCH EXCAVATION PLAN AND SECTIONS			
DESIGNED BY J.H.S.	DRAWN BY J.W.S.		
CHECKED BY L.H.K.	APPROVED BY [Signature]		
SPEC. NO. DACW 99-27-5-2001 DISTRICT PER NO. 244/83 DATE		SHEET 23 OF 24	

FOUNDATION REPORT

2

U.S. ARMY ENGINEER DISTRICT





HORIZONTAL SCALE 1"=100 FT

VERTICAL SCALE 1"=10 FT



SCALE 1"=100 FT



~~1 FOR CROSS SECTIONS, SEE SHEETS 40 AND 41.~~
~~2 FOR INSTRUMENTATION, SEE SHEETS 42, 43 AND 44.~~
~~3 FOR ESTHETIC TREATMENT, SEE SHEETS 72 & 73.~~

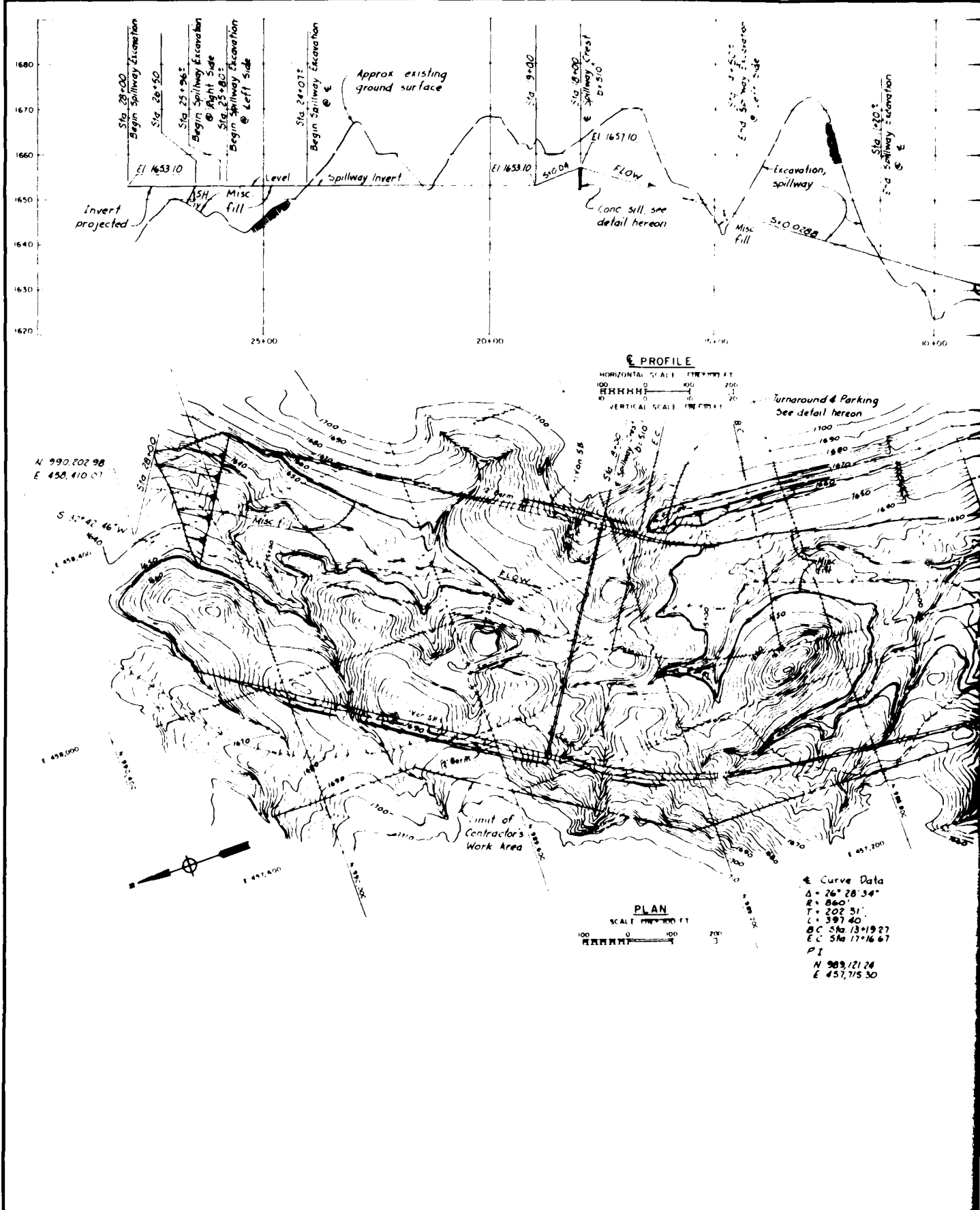
1. TOPOGRAPHY BY PHOTOGRAMMETRIC METHOD
BY AERIAL MAPPING CO SURVEYS OF OCTOBER 1974
CONTOUR INTERVAL IS 2 FEET

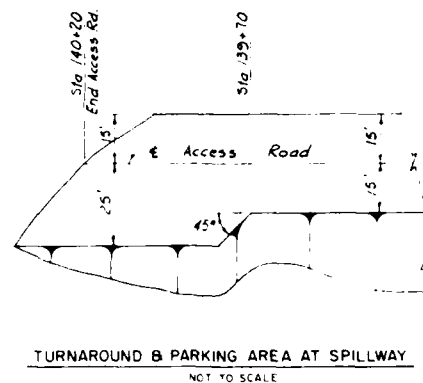
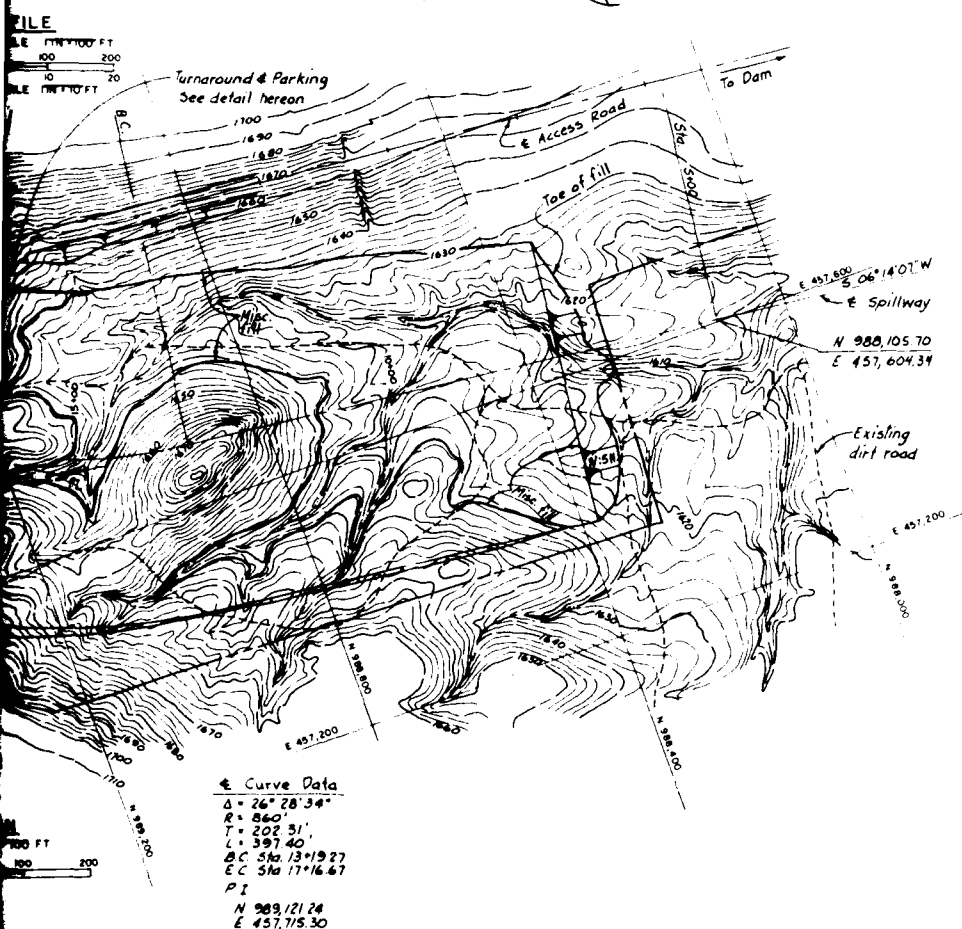
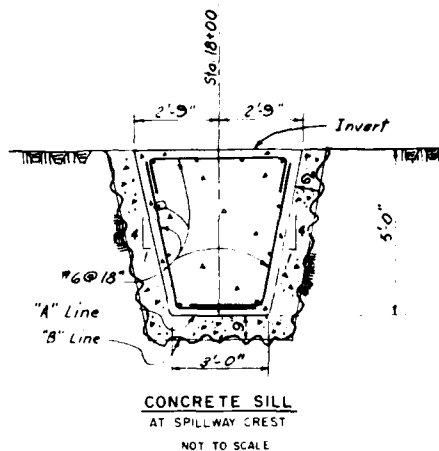
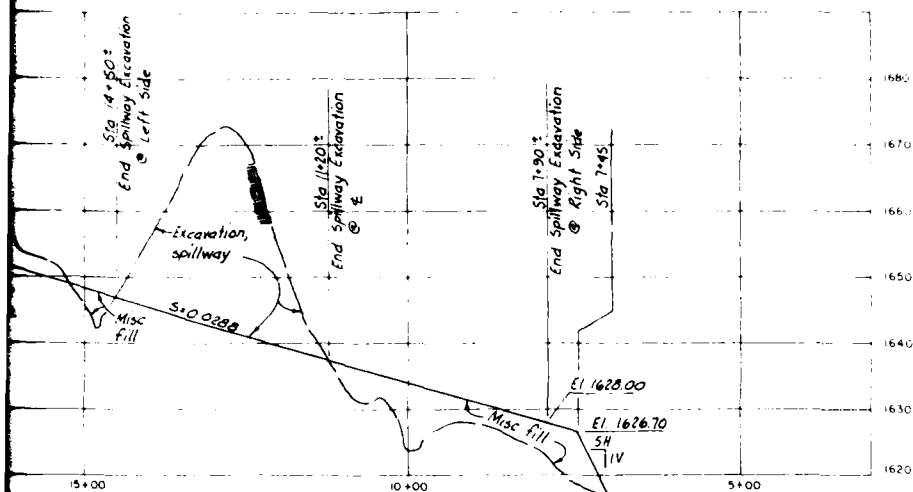
2. HORIZONTAL CONTROL IS BASED ON NATIONAL GEO-
DETIC SURVEY DATUM. VERTICAL CONTROL IS BASED ON
1929 MSL DATUM.

DATE						DATUM IS MEAN SEA LEVEL									
SYMBOL						DESCRIPTION						DATE		APPROVAL	
REVISIONS															
								U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS							
DESIGNED BY: <i>J.H.L.</i>				GILA RIVER BASIN NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA											
DRAWN BY: <i>J.W.S.</i>				CAVE BUTTES DAM DIKE NO. 2 PLAN AND PROFILE STA. 50+23 TO 62+00											
CHECKED BY: <i>H</i>															
REGISTERED OR <i>[Signature]</i> TITLE				APPROVED <i>[Signature]</i> GRADE OF WORKMANSHIP								DRAWN BY SCALE			
APPROVING ENGINEERING OFFICE				SPEC. NO. DRAWING NO. J.E. & CO-EL DISTRICT FILE NO. 244/37								TYPED BY PROJECT			

FOUNDATION REPORT

U.S. ARMY ENGINEER DISTRICT





NOTES:
1 FOR LOCATION OF WASTE AREA FOR EXCAVATED SPILLWAY MATERIALS, SEE SHEET 2, PLATE 2.

Curve Data
 $\Delta = 26^\circ 28' 34''$
 $R = 860'$
 $T = 202' 31''$
 $L = 397' 40''$
 $BC Sta 13+19.27$
 $EC Sta 17+16.67$
 PI
 $N 989,121.24$
 $E 457,715.30$

REFERENCES:

1. Topography by Photogrammetric Method by Aerial Mapping Co. Survey of October 1974. Contour interval as shown.
2. Horizontal control is based on National Geodetic Survey Datum. Vertical control is based on 1929 MSL Datum.

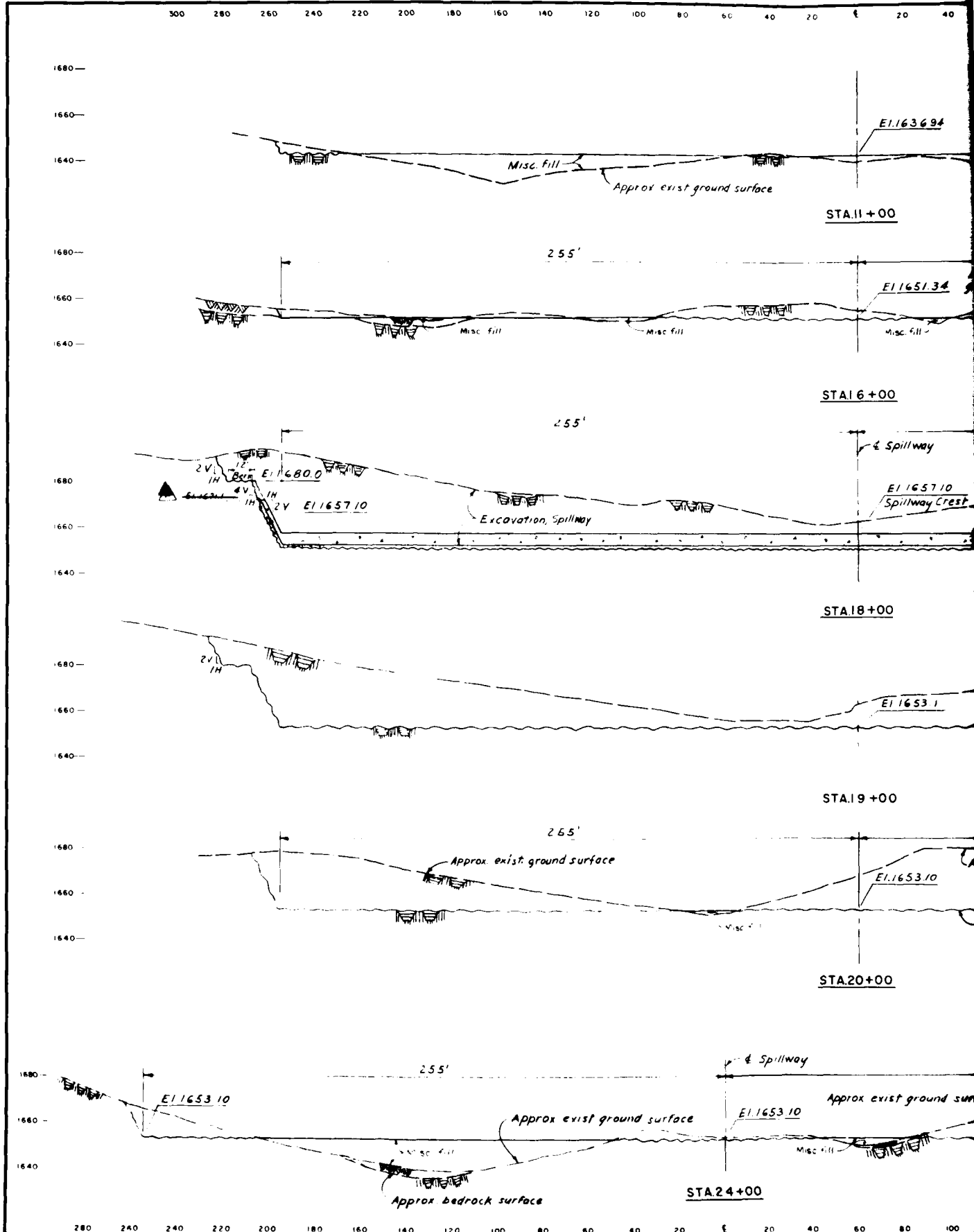
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SYMBOL	DESCRIPTION	DATE	APPROVAL
REVISIONS			
U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS			
GILA RIVER BASIN NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA			
CAVE BUTTES DAM SPILLWAY PLAN AND PROFILE			
DESIGNED BY <i>[Signature]</i>	APPROVED BY <i>[Signature]</i>		
DRAWN BY <i>[Signature]</i>	SPEC. NO. DACW 97-77-0-0031		
CHECKED BY <i>[Signature]</i>	DISTRICT FILE NO. 244/46		
APPROVAL RECOMMENDED	SHEET 46 OF 76 SHEETS		

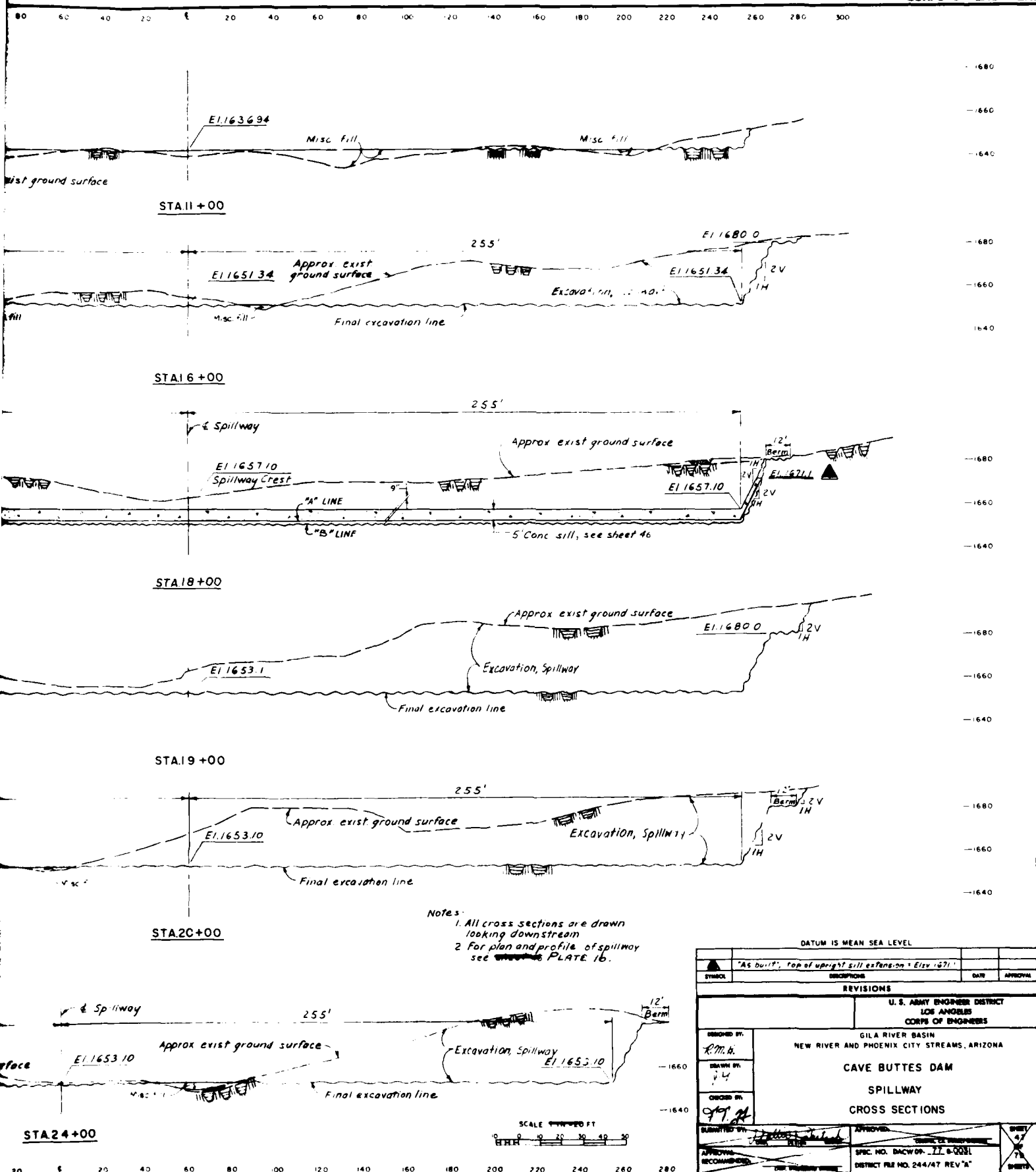
FOUNDATION REPORT

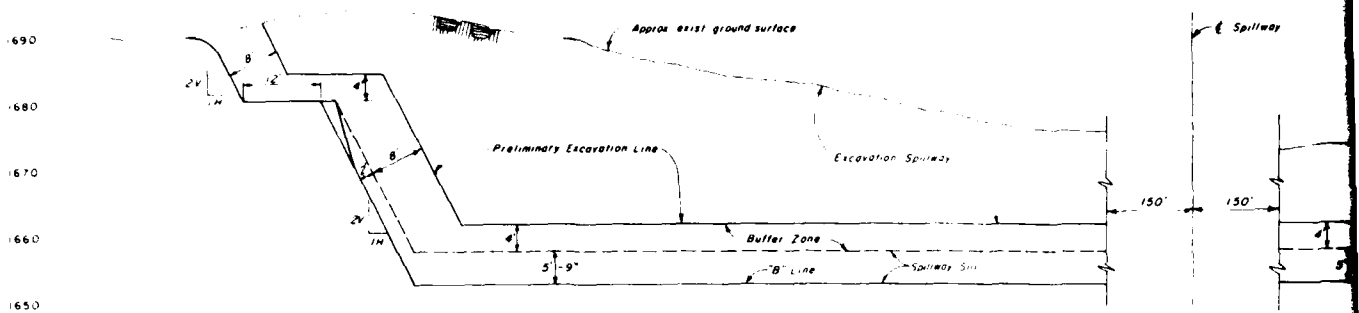
PLATE 16

2

U.S. ARMY ENGINEER DISTRICT







SPILLWAY CREST - STA. 18+00

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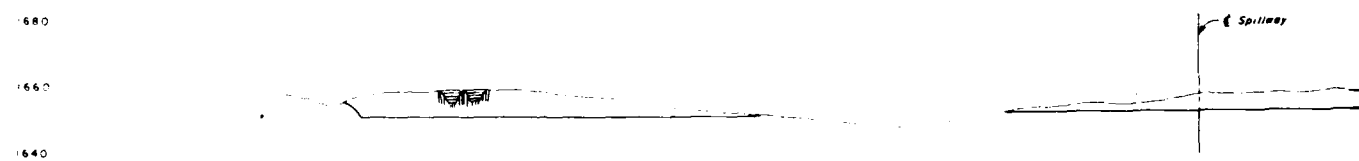
A



STA 13+00



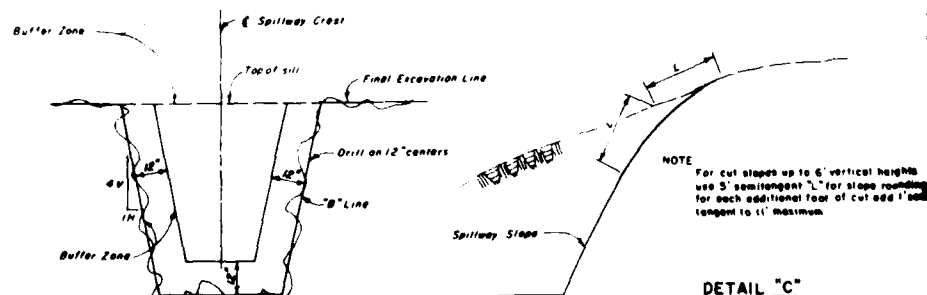
STA 19+00



STA 21+00

SCALE 1"=20 FT

B



DETAIL B

TYPICAL SECTION SPILLWAY SILL

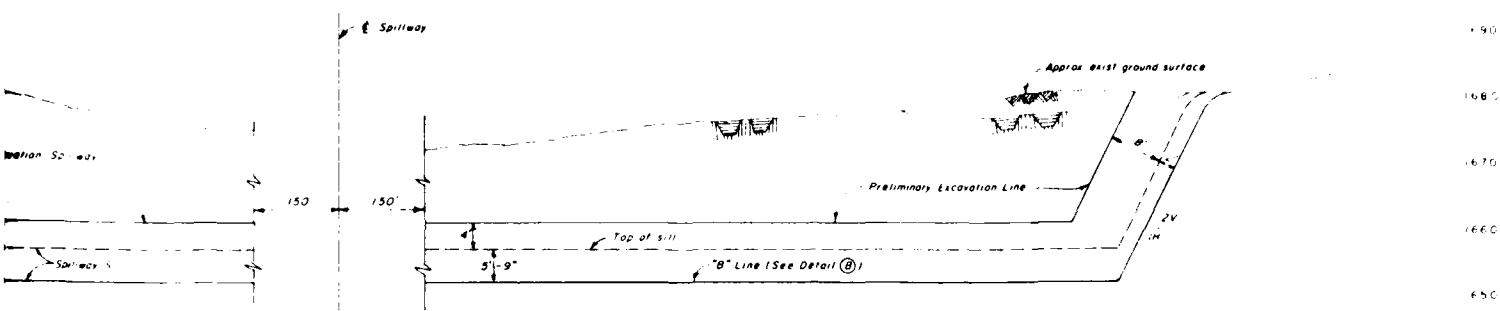
SCALE 1"=2 FT C

DETAIL "C"

TOP SLOPES

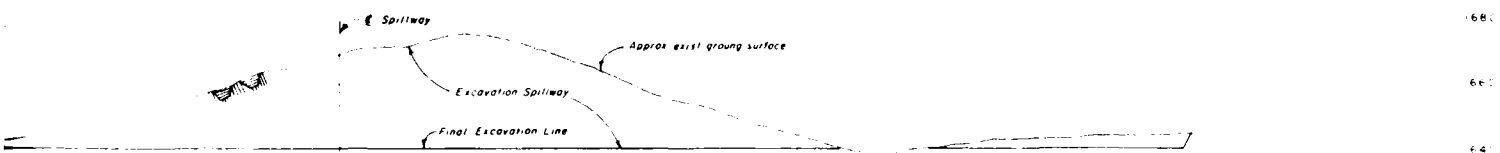
SCALE 1"=40 FT

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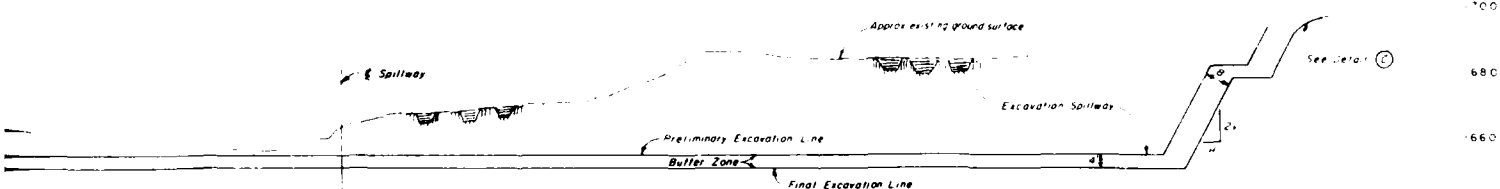


SPILLWAY CREST - STA 18+00

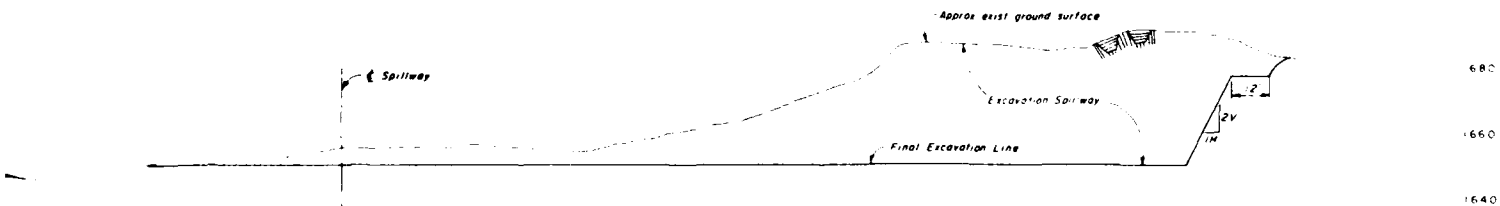
SCALE 1"=40 FT



STA 13+00



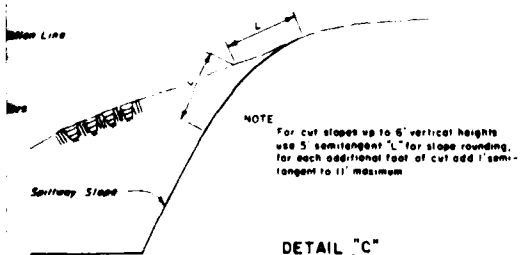
STA 19+00



STA 21+00

SCALE 1"=20 FT

B



DETAIL "C"

TOP SLOPES

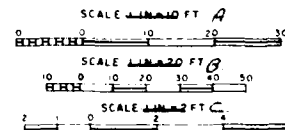
SCALE 1"=40 FT

A

GENERAL NOTES

- 1 ALL SECTIONS ARE LOOKING DOWNSTREAM (DOWNSTATION)
- 2 IN THE AREA BETWEEN STATION 17+00 AND 19+00 ON EITHER SIDE OF THE SPILLWAY CREST, WHERE RIPPING WOULD DAMAGE THE ROCK NEAR THE PRELIMINARY EXCAVATION LINE, SOUND WALL BLASTING METHODS WILL BE USED TO REMOVE THE BUFFER ZONES ACCORDING TO PRESCRIBED METHODS UNDER BLASTING
- 3 CONTRACTOR SHALL SUBMIT PLANS FOR EXCAVATIONS BY BLASTING
- 4 SEE SHEET 16 FOR PLAN VIEW

PLATE 16

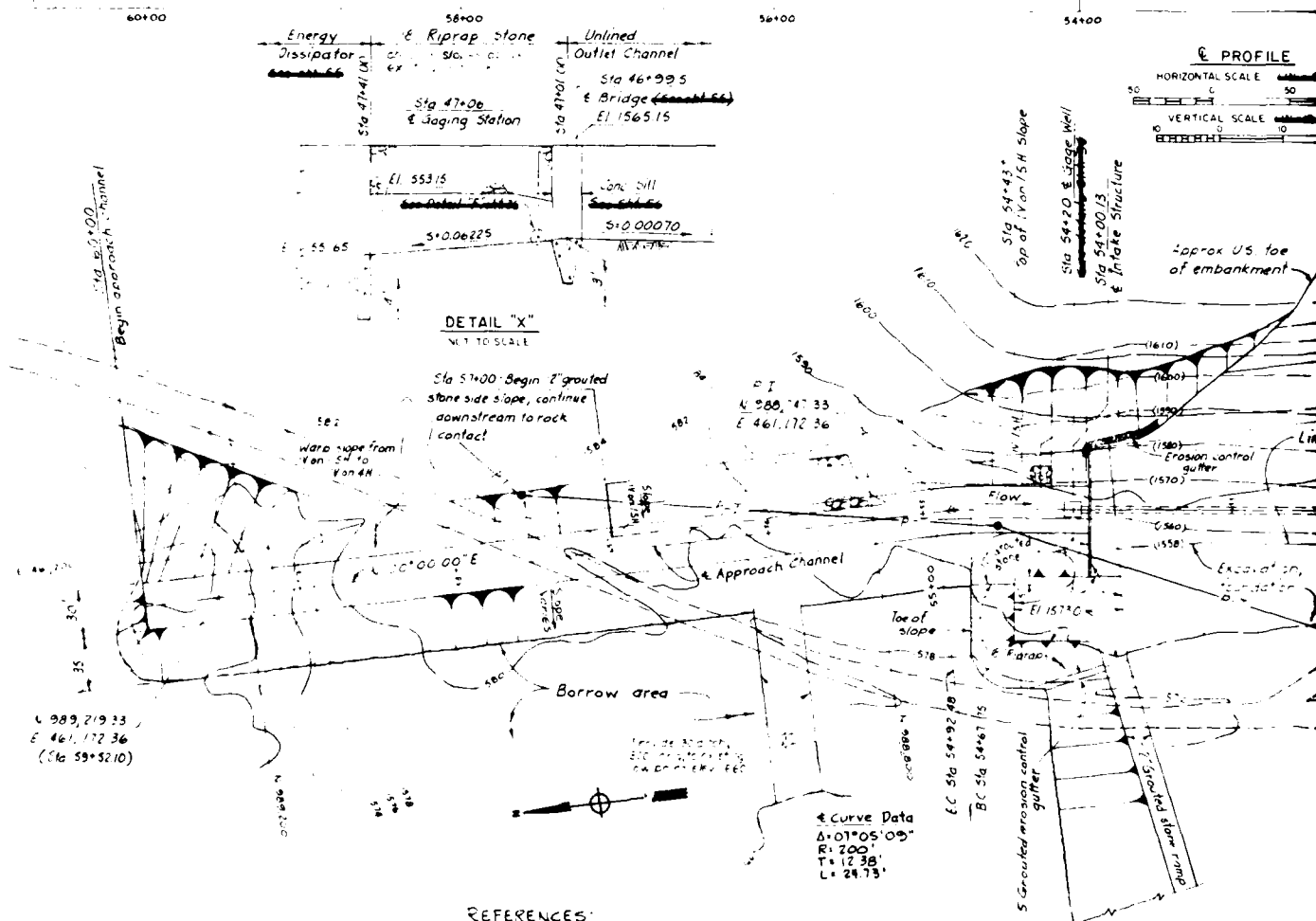
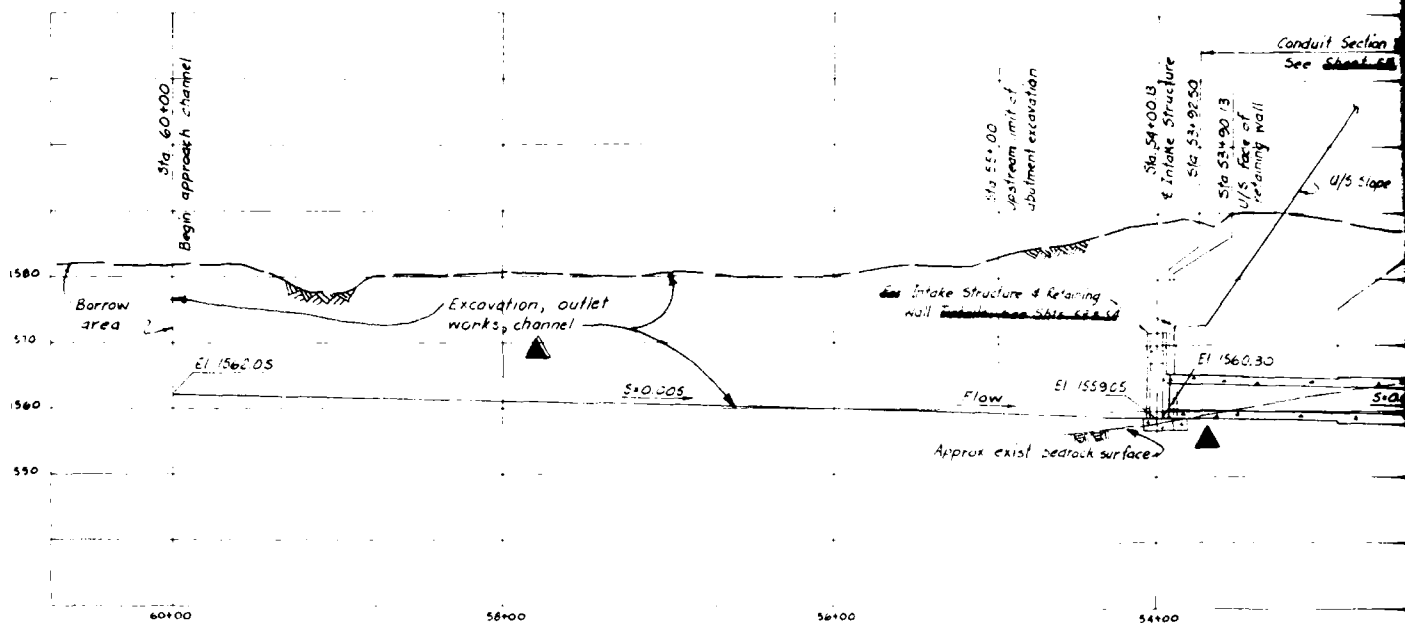


SYMBOL		DESCRIPTION	DATE	APPROVAL
REVISIONS				
U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS				
SILA RIVER BASIN NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA				
CAVE BUTTES DAM				
SPILLWAY				
ROCK EXCAVATION DETAILS				
DESIGNED BY <i>R.M.H.</i>	DRAWN BY <i>P.Y.</i>			
CHECKED BY <i>P.Y.</i>	APPROVED <i>[Signature]</i>			
ENGINEER <i>[Signature]</i>	DISTRICT FILE NO. 244/48			
APPROVAL <i>[Signature]</i>	DATE: <i>11-1-48</i>			

FOUNDATION REPORT

2

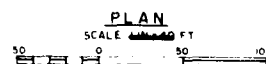
PLATE 16

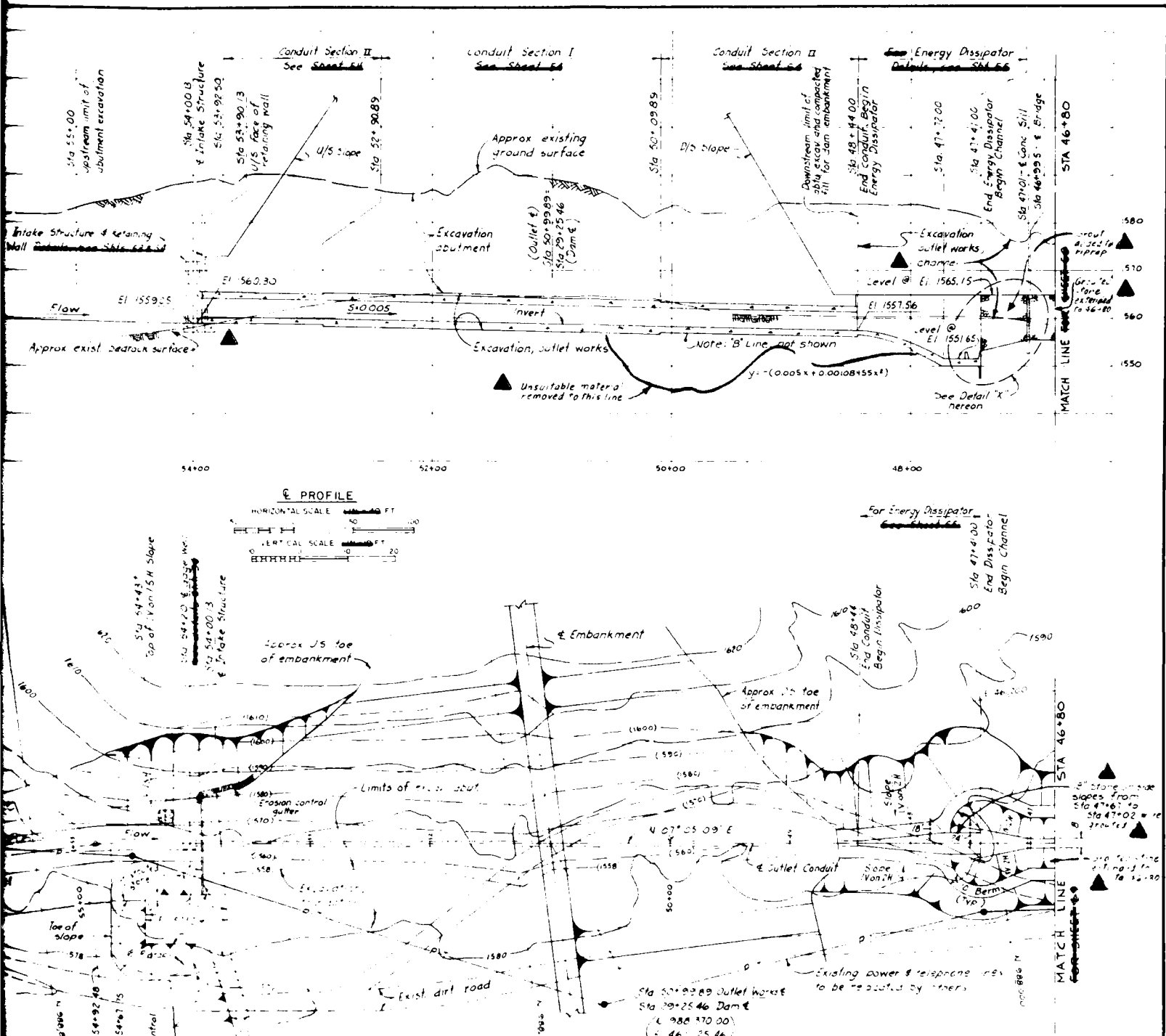


REFERENCES

Topography by photogrammetric method
by Aerial Mapping Co Survey of October 94

2 Horizontal control is based on National Geodetic Survey Datum vertical control is based on 1929 MSL Datum





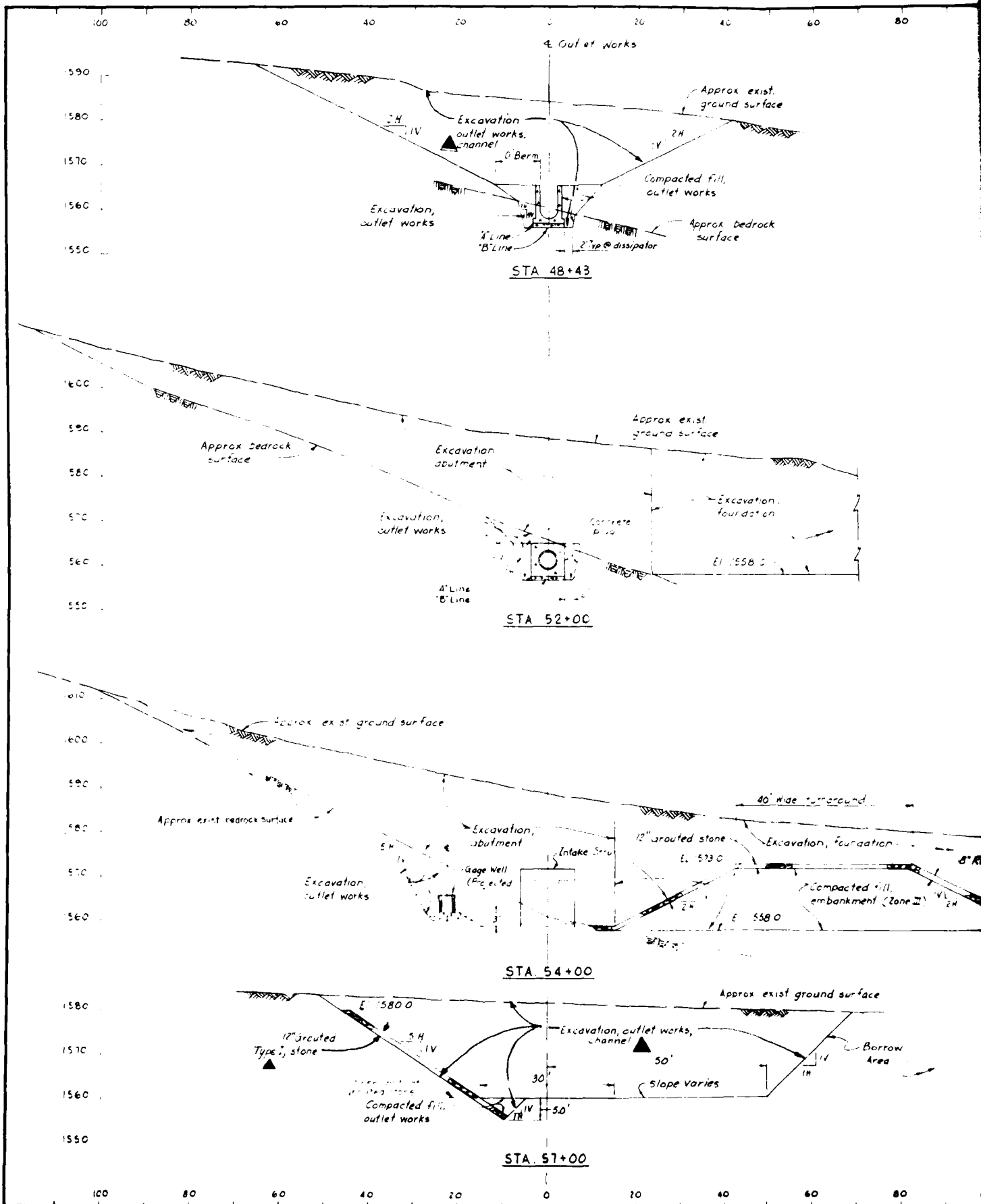
REFERENCE DRAWINGS PLATE 20
 FOR CROSS SECTIONS SEE SHEET 40
 FOR INTAKE STRUCTURE SEE SHEET 41
 FOR ENERGY DISSIPATOR SEE SHEET 42

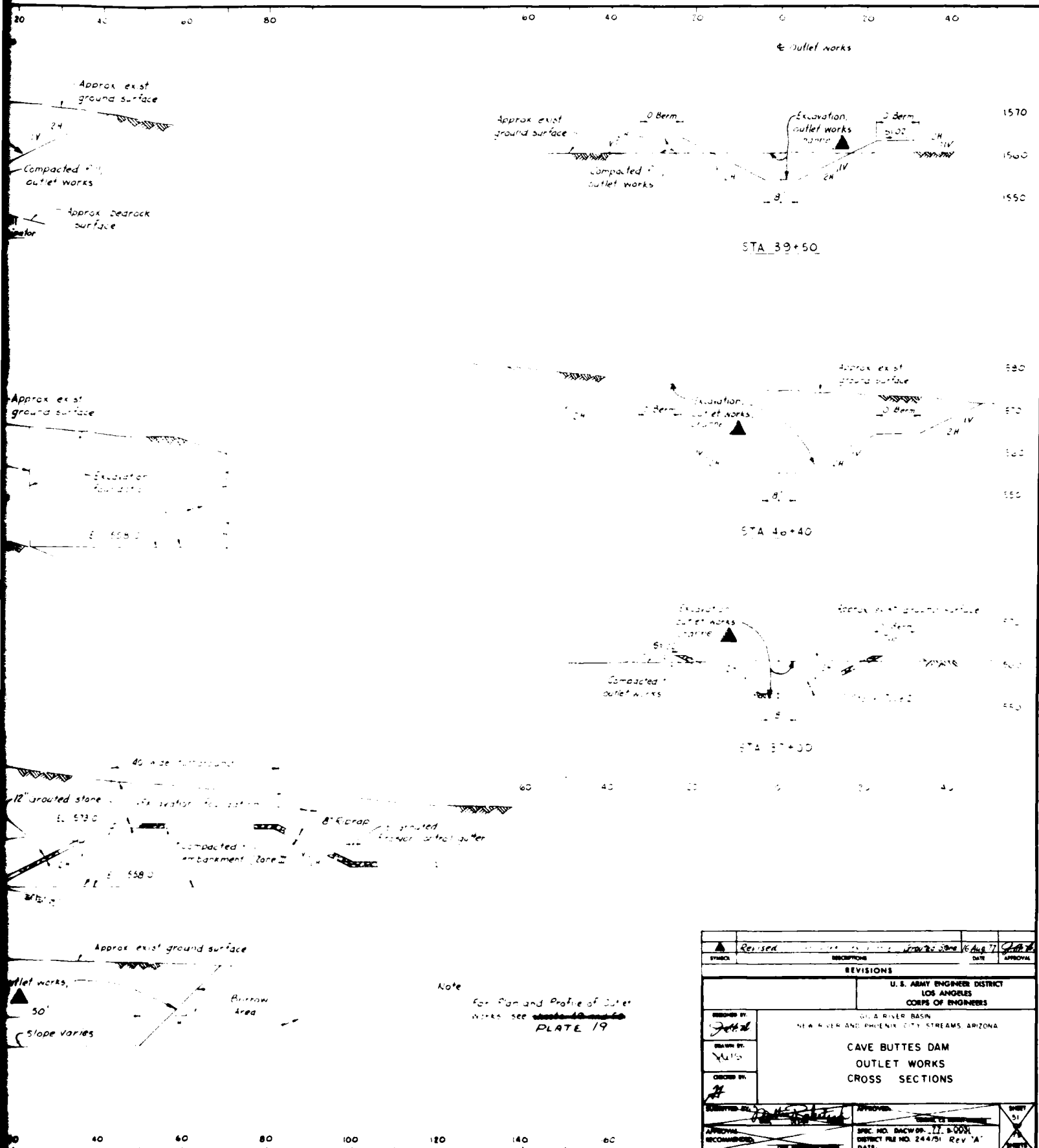
LEGEND

- 1610 — Approx exist. ground surface
- (1590) — Approx exist. bedrock surface
- Existing power pole

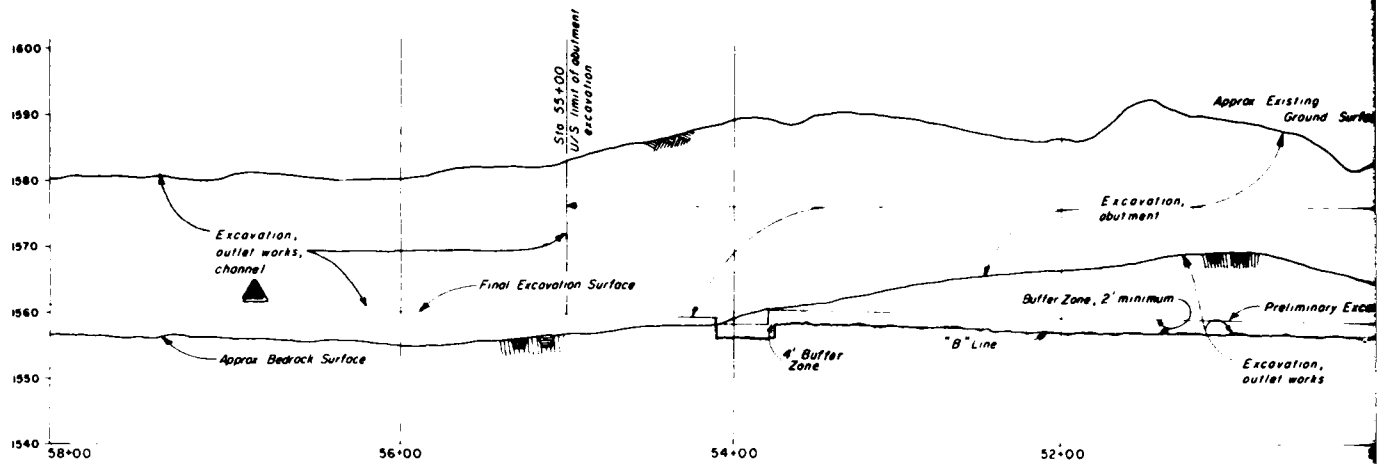
Added "As built" details to excavation and integrated into... SYMBOL: 10-10		DATE: 12-1-77	APPROVAL: [Signature]
REVISIONS			
U.S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS			
DESIGNED BY: [Signature] DRAWN BY: XWS CHECKED BY: [Signature]	GILA RIVER BASIN NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA CAVE BUTTES DAM OUTLET WORKS PLAN AND PROFILE STA 60+00 TO STA 46+80		
RECOMMENDED BY: [Signature] APPROVAL: [Signature]	SPEC. NO. DACW 09-77-8-0031 DISTRICT FILE NO. 244/49 REV. "A" DATE:		SHEET 49 OF 50 SHEETS

2

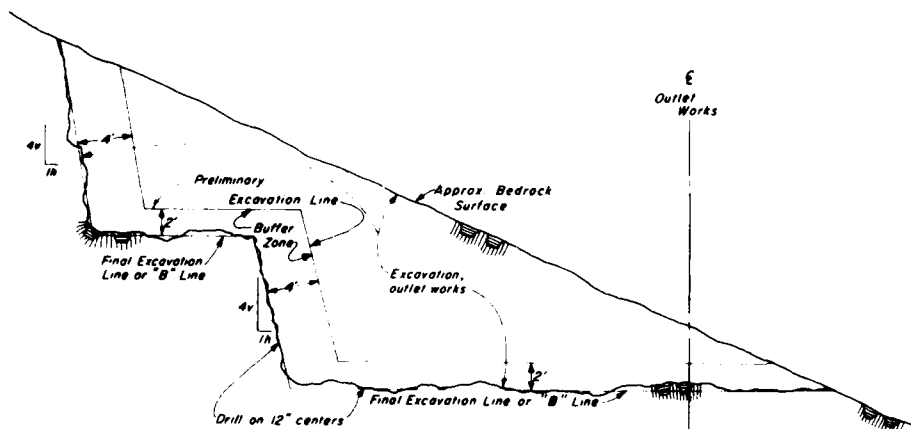
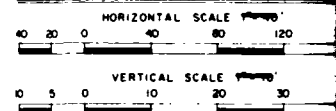




Revised		16 Aug 77		J. H. B.	
SYMBOL	REVISIONS	DATE	APPROVAL		
U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS					
SAN JUAN RIVER BASIN NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA					
CAVE BUTTES DAM OUTLET WORKS CROSS SECTIONS					
DESIGNED BY J. H. B.					
DRAWN BY X. M. S.					
CHECKED BY J. H. B.					
APPROVED BY J. H. B.					
SPEC. NO. BACWSP-17, 600X		DISTRICT FILE NO. 244/51		Rev. 'A'	
DATE		DATE		DATE	

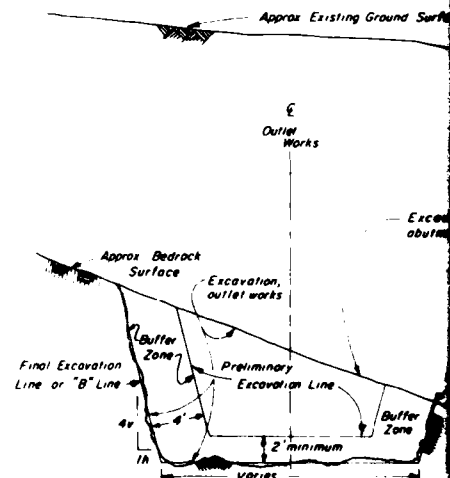


PROFILE ALONG ϵ OUTLET WORKS

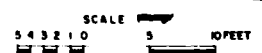


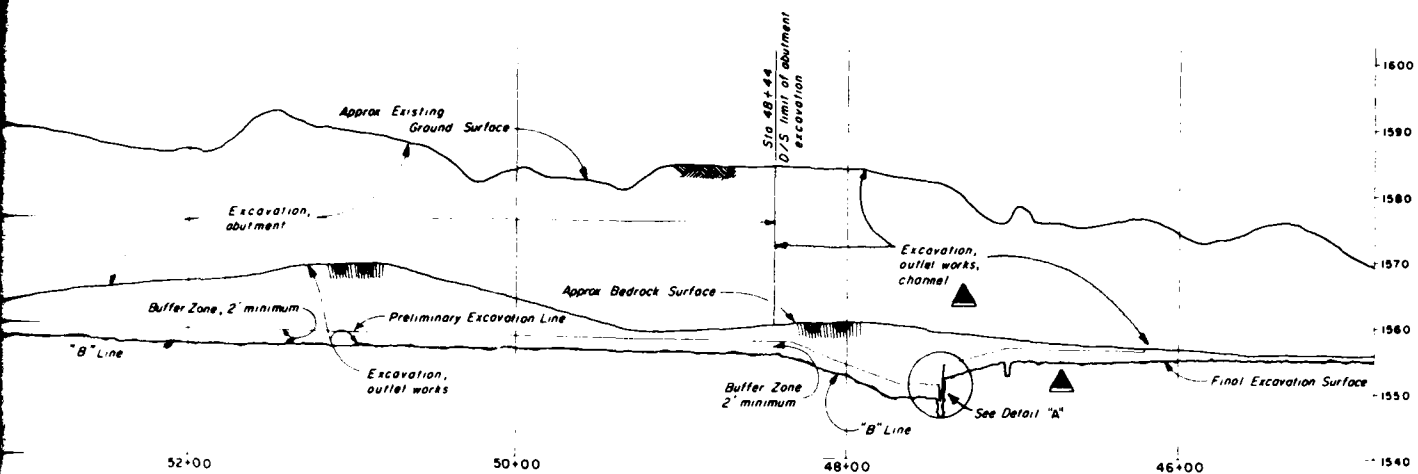
TYPICAL SECTION AT RETAINING WALL

SCALE 1" = 10'

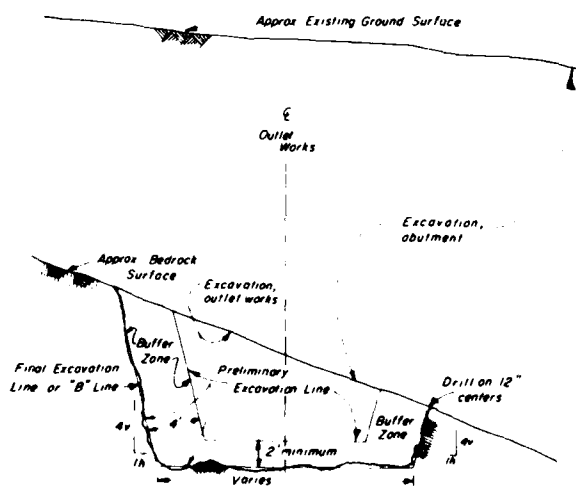
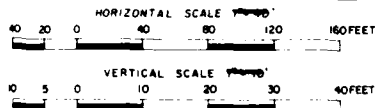


TYPICAL SECTION OUTLET WORKS

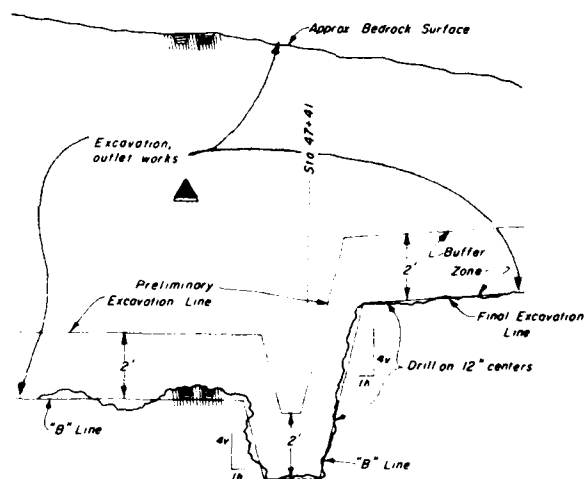
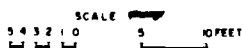




PROFILE ALONG ϵ OUTLET WORKS



TYPICAL SECTION OUTLET CONDUIT



DETAIL A



GENERAL NOTES

- 1 IN THE AREA BETWEEN STATION 53+87 AND 46+00 ALONG THE OUTLET WORKS WHERE RIPPING WOULD DAMAGE THE ROCK FACE NEAR THE PRELIMINARY EXCAVATION LINE, SOUND WALL BLASTING METHODS WILL BE USED TO REMOVE THE BUFFER ZONES ACCORDING TO PRESCRIBED METHODS UNDER BLASTING
- 2 CONTRACTOR SHALL SUBMIT PLANS FOR EXCAVATIONS BY BLASTING
- 3 SEE ~~SECTION 1000~~ FOR PLAN VIEW

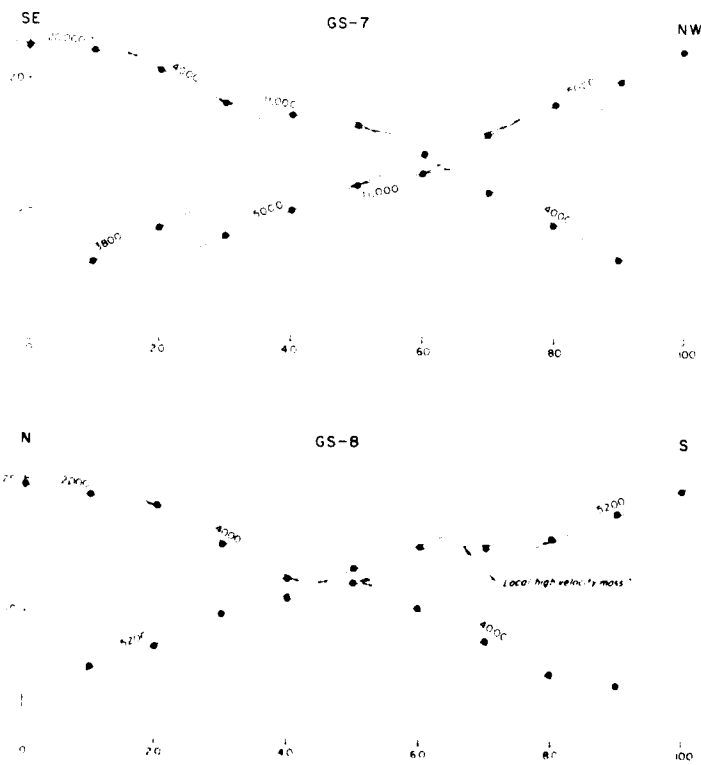
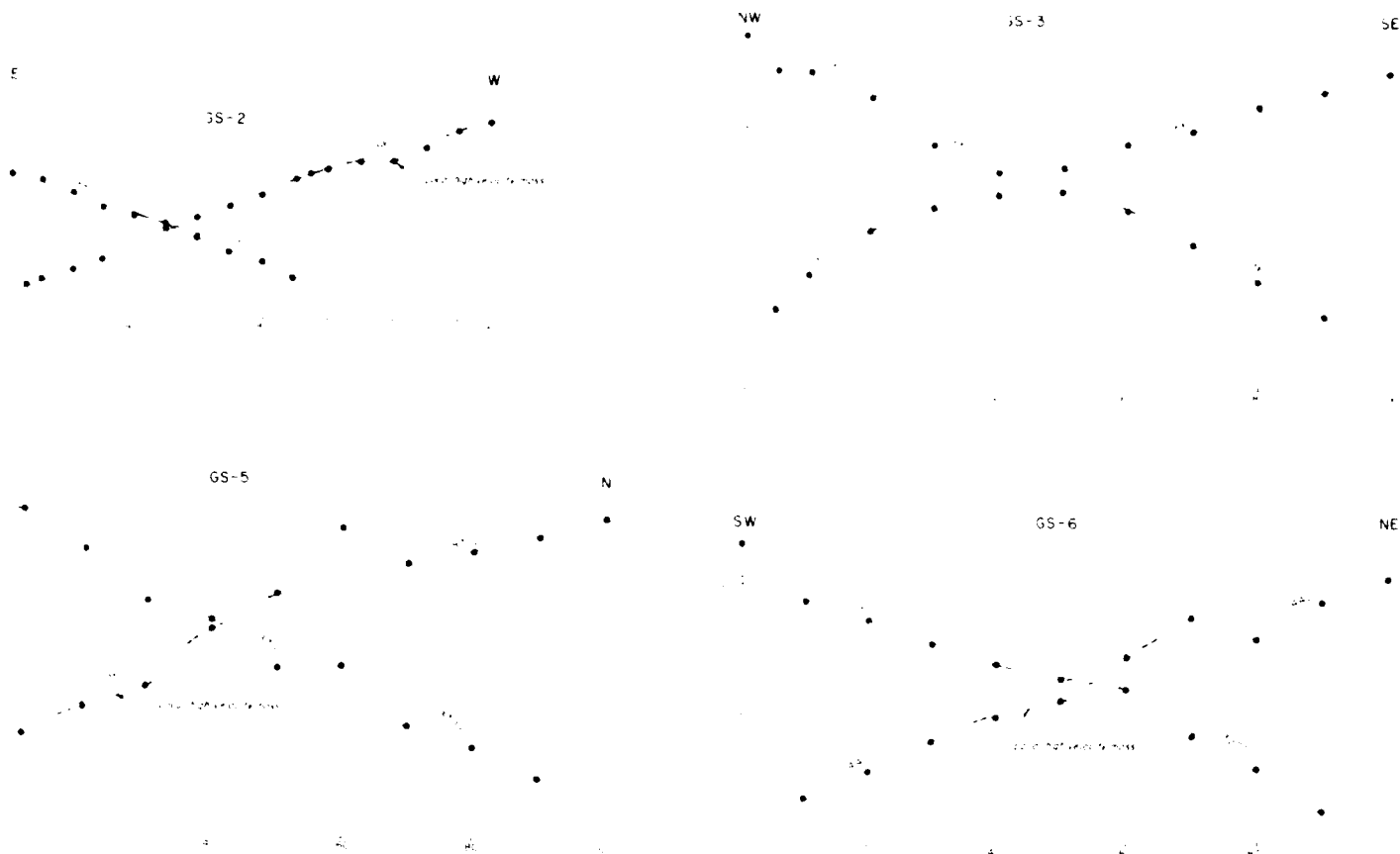
PLATE 19

DATUM IS MEAN SEA LEVEL			
SYMBOL	DESCRIPTION	DATE	APPROVAL
	Revised notes and limits of excavation for outlet works	12 Aug 77	
REVISIONS			
U. S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS			
GILA RIVER BASIN NEW RIVER AND PHOENIX CITY, TREAS, ARIZONA			
CAVE BUTTES DAM OUTLET WORKS ROCK EXCAVATION DETAILS			
DESIGNED BY 	CHECKED BY 	APPROVED BY 	SHEET 32
SPEC. NO. DACW 09-77-80001 DISTRICT FILE NO. 244/02 REV "A"		DATE:	19

FOUNDATION REPORT

2

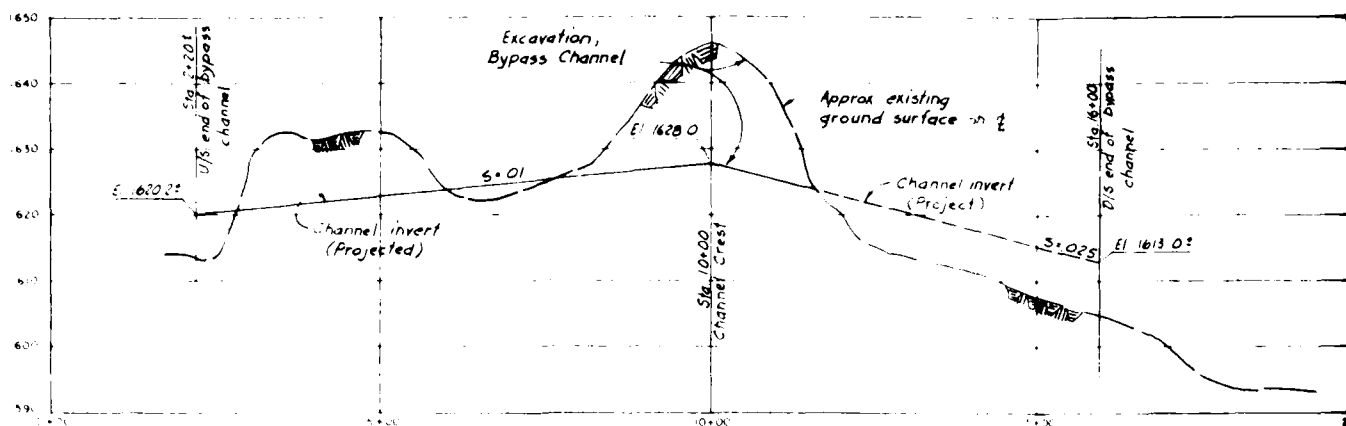
PLATE 21



NOTES

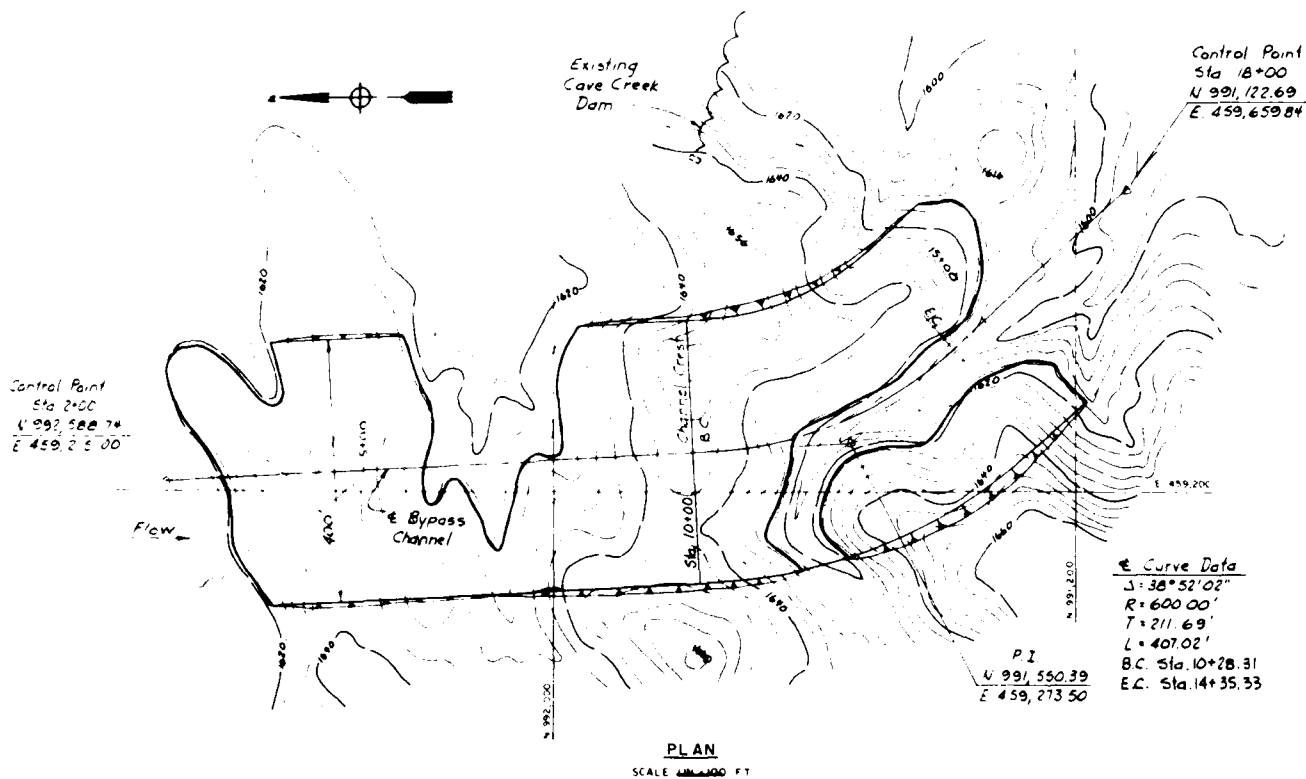
1. The ~~data~~ legend **PLATE 9**
2. All lines were plotted by personnel of the Los Angeles District Corps of Engineers using a Graph Metric Model with Seismic Timer.
3. Granite is not exposed in outcrops.
4. R.C. Altered Granite is exposed in outcrops and is closely related to ground surface.
5. R.C. Greenstone is darker, finer grained and more closely related to the altered granite. At the surface the rock has a glassy appearance. In outcrops, quartzite lenses are more massive and harder than the greenstone and may account for high velocity breaks in the records.
6. GS-1 thru B: Seismic Refractive line
7. Average Seismic Velocity: Feet/Second

DATUM IS MEAN SEA LEVEL			
SYMBOL	DESCRIPTION	DATE	APPROVAL
REVISIONS			
U.S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS			
DESIGNED BY: R. G. H.	GILA RIVER BASIN NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA CAVE BUTTES DAM BYPASS CHANNEL GEOLOGY SEISMIC REFRACTIVE SURVEY TIME-DISTANCE CURVES		
DRAWN BY: R. J. I.			
CHECKED BY: J. T.			
APPROVED BY: [Signature]	APPROVED BY: [Signature]		
RECOMMENDED BY: [Signature]	SPEC. NO. DACW 09-222, 8-0031 DISTRICT FILE NO. 244/77 DATE:		
FOUNDATION REPORT		2	



PROFILE

HORIZONTAL SCALE 1" = 100' 1" = 100'
 VERTICAL SCALE 1" = 10' 1" = 10'

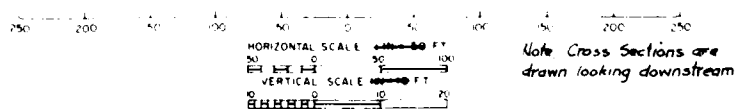
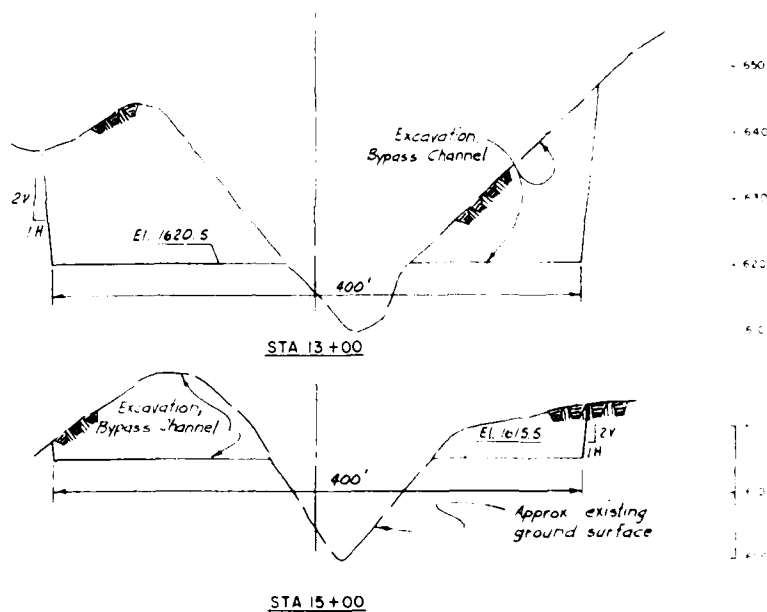
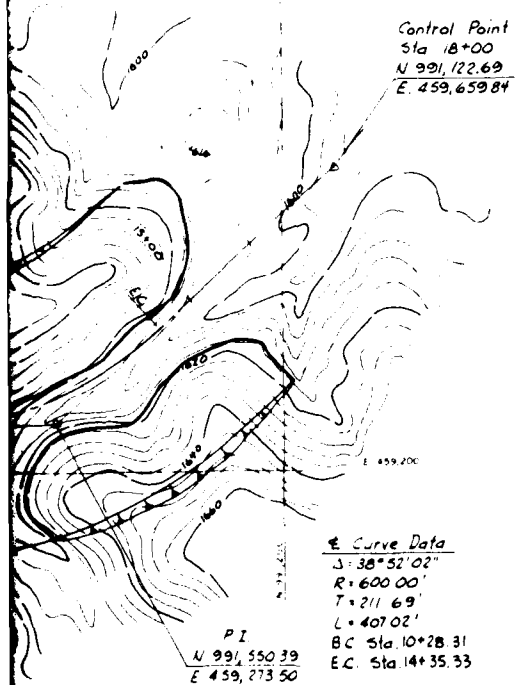
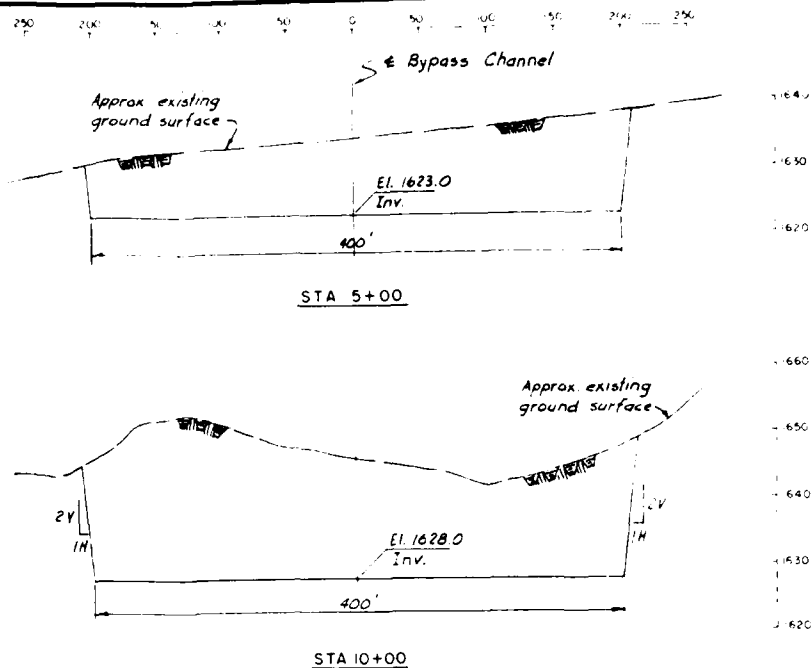
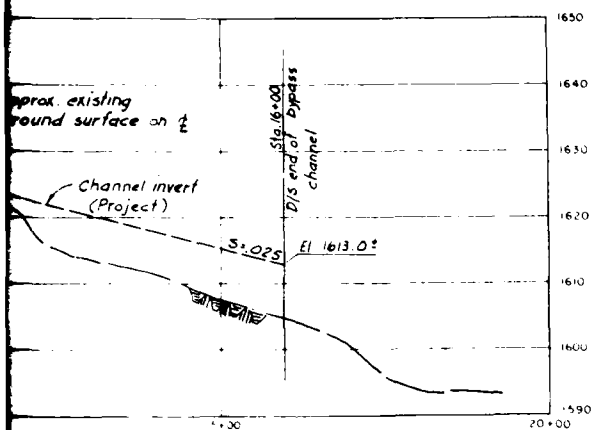


PLAN

SCALE 1" = 100' 1" = 100'

Curve Data

Δ = 36° 52' 02"
 R = 600.00'
 T = 211.69'
 L = 407.02'
 P.I. Sta 10+28.31
 B.C. Sta 10+28.31
 E.C. Sta 14+35.33



REFERENCES:

1. Topography by Photogrammetric Method by Palford and Associates. Survey of July 1969.
2. Horizontal control is based on National Geodetic Survey Datum. Vertical control is based on 1929 MSL Datum.

SYMBOL	DESCRIPTION	DATE	APPROVAL
REVISIONS			
U.S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS			
GILA RIVER BASIN NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA			
CAVE BUTTES DAM BYPASS CHANNEL PLAN, PROFILE AND SECTIONS			
DESIGNED BY <i>gws</i>	APPROVED BY <i>[Signature]</i>		
DRAWN BY <i>gws</i>	CHECKED BY <i>[Signature]</i>		
CHECKED BY <i>[Signature]</i>	APPROVED BY <i>[Signature]</i>		
APPROVED BY <i>[Signature]</i>	APPROVED BY <i>[Signature]</i>		
SPEC. NO. BACW 69-11, 8-0031 DISTRICT FILE NO. 244/78 DATE:		SHEET 78 OF 78	

FOUNDATION REPORT

2

PLATE 23

US ARMY ENGINEER DISTRICT

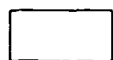
LEGEND



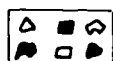
Qal Quaternary - Recent Alluvium: Streambed, flood plain and unconsolidated valley fill deposits; clay, silt, sand, gravel, cobbles and boulders, generally unconsolidated but occasional cemented intervals and lenses.



Qoal Quaternary - Older Alluvium: Terrace, slope wash deposits and talus debris, clay, silt, sand, gravel, cobbles and boulders; partly consolidated valley fill with consolidated intervals and lense of cemented materials



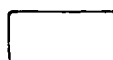
Qtb Quaternary or Tertiary - Basalt: dark gray or black to reddish brown, fine grained, dense to vesicular; commonly vesicular and vuggy, hard and blocky to brecciated, occasional layers of ash, scoria, tuff and tuffaceous agglomerate.



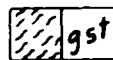
QTt Quaternary or Tertiary - Tuff, Agglomeritic tuff and tuffaceous agglomerate: Light brown to buff, soft to hard, angular to subangular clasts of green metaigneous rock and dense to vesicular basalt to 3 1/2 inches maximum diameter in a fine grained, well cemented tuffaceous matrix, material becomes more agglomeratic with increase in depth.



QTi Quaternary or Tertiary intrusive rocks: Includes pods, lenses and dikes of "younger" granite and a few dikes of various intrusive rocks. They are identified individually on the plates using a scale of 1 inch=10 feet. No specific age dates are available for any rock in this group.



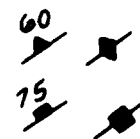
Gr Precambrian - Granite and granocliorite: medium to fine grained, contains inclusions of basement rocks, hard but highly fractured and blocky, partly weathered on fractures.



B.C. Precambrian - Basement Complex: gray green to dark green, metaigneous rock, soft to hard fine grained alternately schistose and massive, closely fractured, but mostly along older recemented fractures, locally meta-andesite, gst=greenstone.



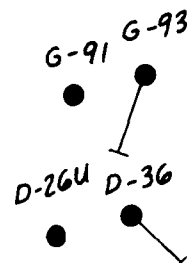
Fault, showing dip, dashed where approximate, dotted where existence is uncertain. Long arrows show relative movement.



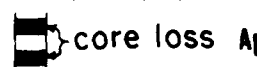
Foliation, strike and dip (in degrees), vertical, strike shown.

Joints, strike and dip (in degrees), vertical, strike shown.

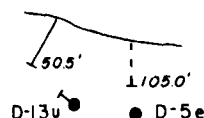
Contact between



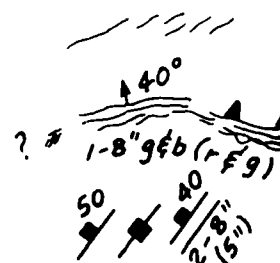
R.B. or rockbit



5.8		no test
12.2	10	
	10	
20.5	20	
	10	no loss
	20	
35.0	30	
4		



Large st



91

LEGEND (Cont.)

Contact between alluvium and bedrock types (Plates 3 and 4)

6-93 Grout holes, vertical, inclined, EX size plug bit used.

Length of grout and core holes are horizontal projection of the true length (Plates using 1"=10' scale.)

36 Diamond core holes, vertical and inclined, NX size.

rockbit Portion of core hole not cored (used tri-cone rockbit)

re loss Approximate interval of core loss (in bedrock intervals only)

Water Pressure Test

	no test
0	
0	
0	
0	
0	no loss
0	
0	
0	

Pressure test, accomplished using single packer

Depth, number of feet below collar of hole.

PSI, Pounds per square inch (water pressure)

GPM, gallons per minute water loss

No test, interval not tested

No loss, no water loss at pressure shown

Packer leaked, water leaked around packer.

Diamond core drill holes (shown on small scale section) inclined and vertical, dashed where projected.

Diamond core holes, inclined and vertical (on small scale plan)

Large scale items used on Plates with 1"=10' scale

Contact between alluvium and bedrock or types of each, hachured where gradational.

Fault or shear zone, dashed = approximate location,

dotted concealed, ? = existence uncertain,

1-8" = range of thickness, g&b = gouge and breccia,

(r&g = color is red and green, (brwn) = brown (y) = yellow, etc.

Joints (strike and 50° dip), (strike and vertical) (sheeted, strike, 40° dip, spaced 2-8" apart, average spacing 5 inches)

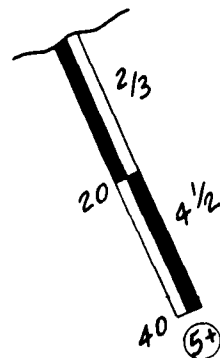
Point of surface leakage of grout

Location of surface treatment with slurry grout or dental concrete.

Granite dikes lenses or pods.

LEGE

Grout hole detail collar of the hole number is number of left side number the stage was grout of cement placed



GENE

1. Grout header pipe, holes drilled number of discontinuities to place a spaced grout hole locations, inclination in field, mix ratios (water to cement) only during surface leaks or large tail

2. Grout hole lengths shown in true length. Apparent dip of grout hole by stereonet. See Plates 57 and 58 for

3. Geology for Plates 25-56 mapped January through August 1978. Geology of 1970 through 1975.

4. For location of all diamond core See Plate 4. See Plates 6 and 7 for location of profiles or sections A-A See Plate 5 for geologic sections.

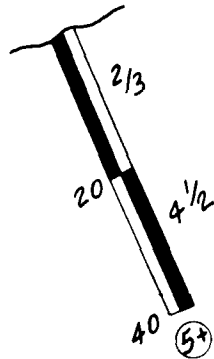
5. See Plates 25-56 for plan showing geology mapped in 1978.

6. The term "greenstone" represents rock, even when brilliant red or yellow are seen.

7. Soil classification on geologic

8. Data on engineering characteristics condition of foundations composed of emplacement of embankments, overburden are presented in Phase II, Part I of the

LEGEND (Cont.)



Grout hole detail ground surface and collar of the hole at top, right side number is number of sack placed in the stage, left side number is drilled depth of hole when the stage was grouted, circle shows total sacks of cement placed in the hole as neat cement grout.

GENERAL NOTES

1. Grout header was connected directly to the grout pipe, holes drilled at angles to intersect maximum number of discontinuities to place a more effective grout curtain, split spaced grout hole locations, inclinations and direction were determined in field, mix ratios (water to cement) were thin (5.1 to 7.1), thickened only during surface leaks or large takes.
2. Grout hole lengths shown in plan are horizontal projections of the true length. Apparent dip of grout holes on profiles or sections determined by stereonet. See Plates 57 and 58 for grouting data.
3. Geology for Plates 25-56 mapped summer 1978, grouting was done January through August 1978. Geology on Plates 3-23 from investigations of 1970 through 1975.
4. For location of all diamond core holes of 1970 through 1975, See Plate 4. See Plates 6 and 7 for geologic logs. See Plate 3 for location of profiles or sections A-A through D-D, of section E-E See Plate 4. See Plate 5 for geologic sections.
5. See Plates 25-56 for plan showing grout hole locations and geology mapped in 1978.
6. The term "greenstone" represents the green massive metaigneous rock, even when brilliant red or yellow shades resulting from iron oxides are seen.
7. Soil classification on geologic logs are visual.
8. Data on engineering characteristics of overburden materials, condition of foundations composed of overburden materials, data on emplacement of embankments, overburden excavation and instrumentation are presented in Phase II, Part I of the G.D.M.

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

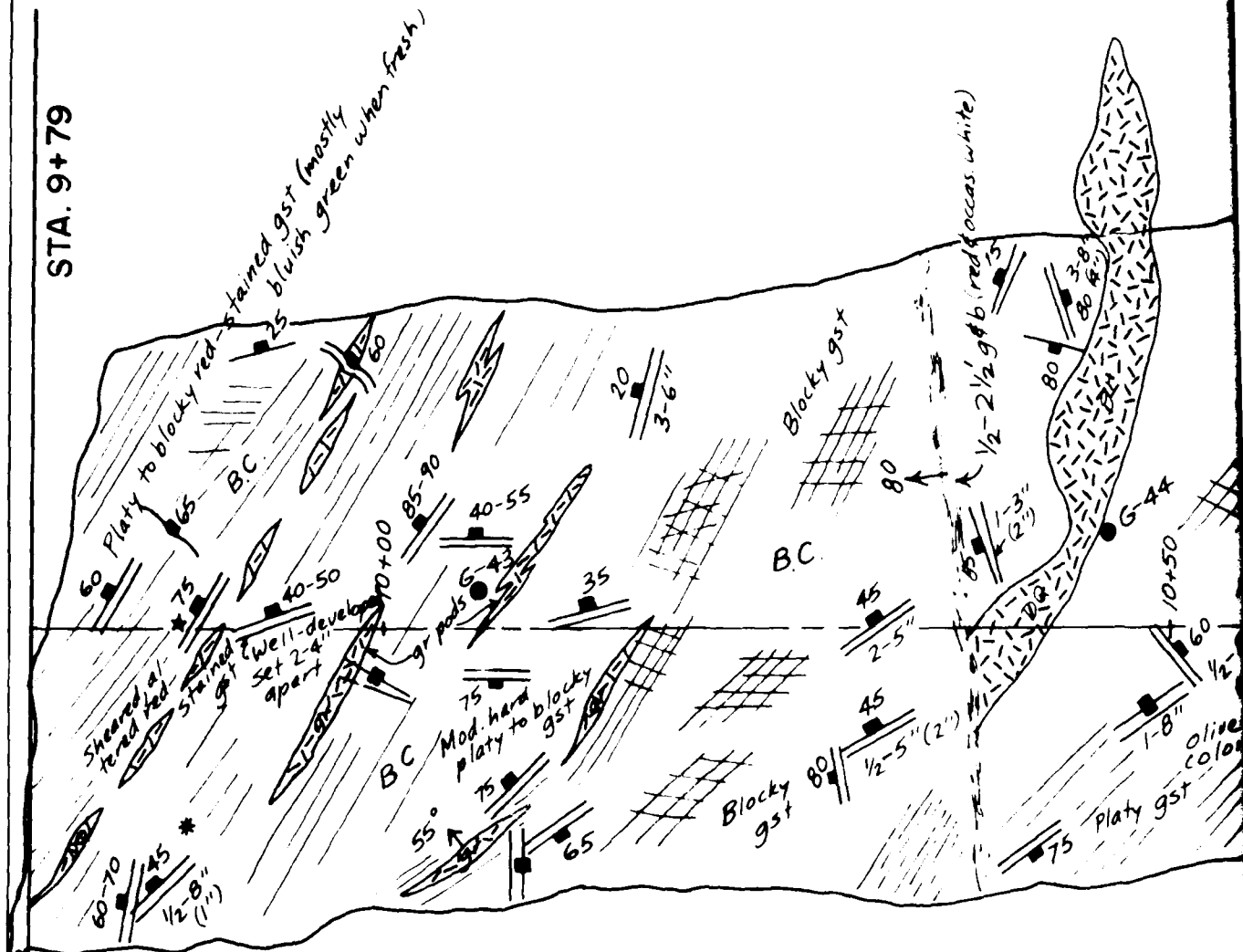
CAVE BUTTES DAM
LEGEND AND GENERAL NOTES

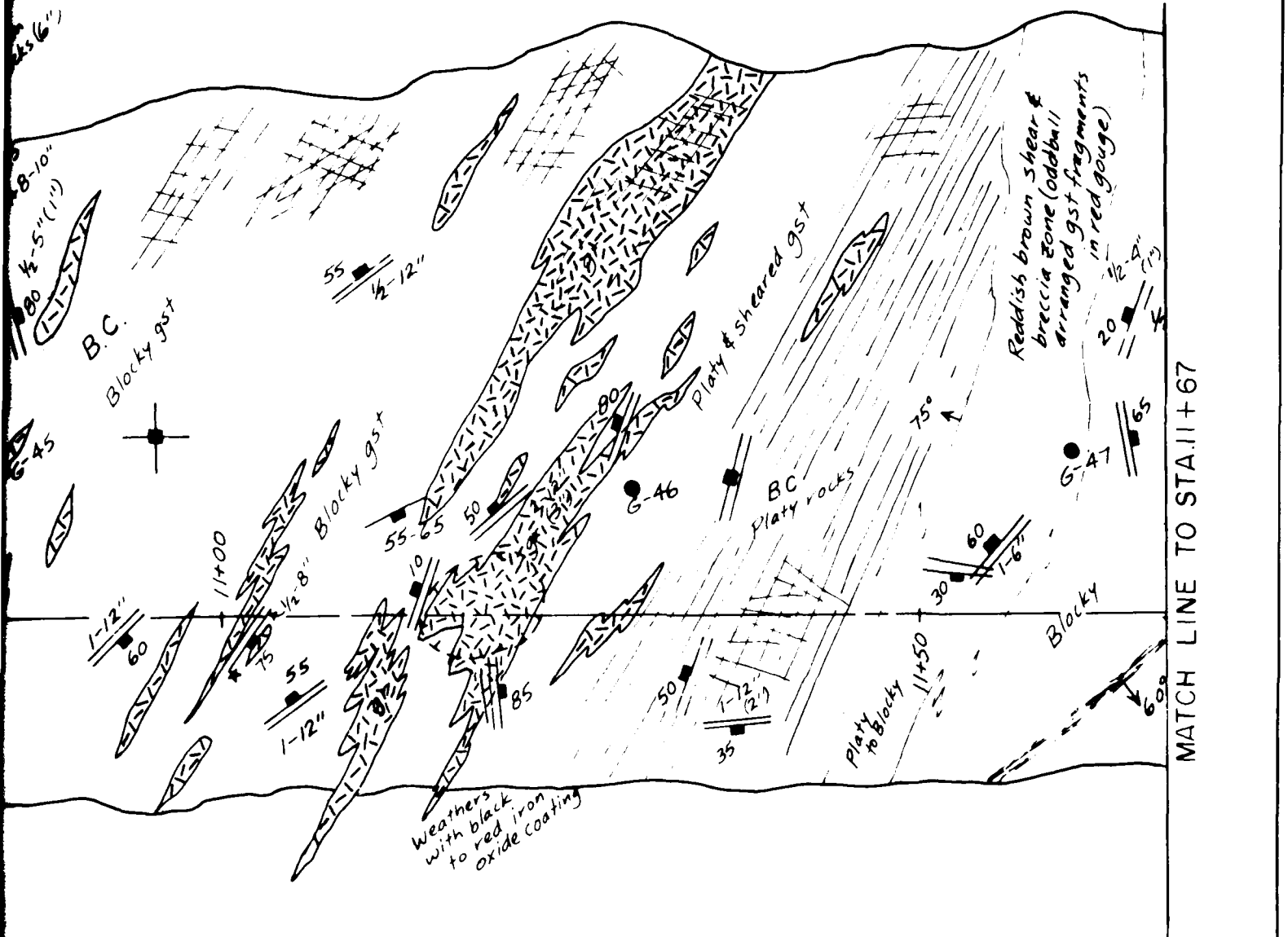
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

U.S. ARMY ENGINEER DISTRICT

STA. 9+79

BEGIN RIGHT ABUTMENT





1 IN = 10 FT

10 0 10
SCALE FEET

NOTE:

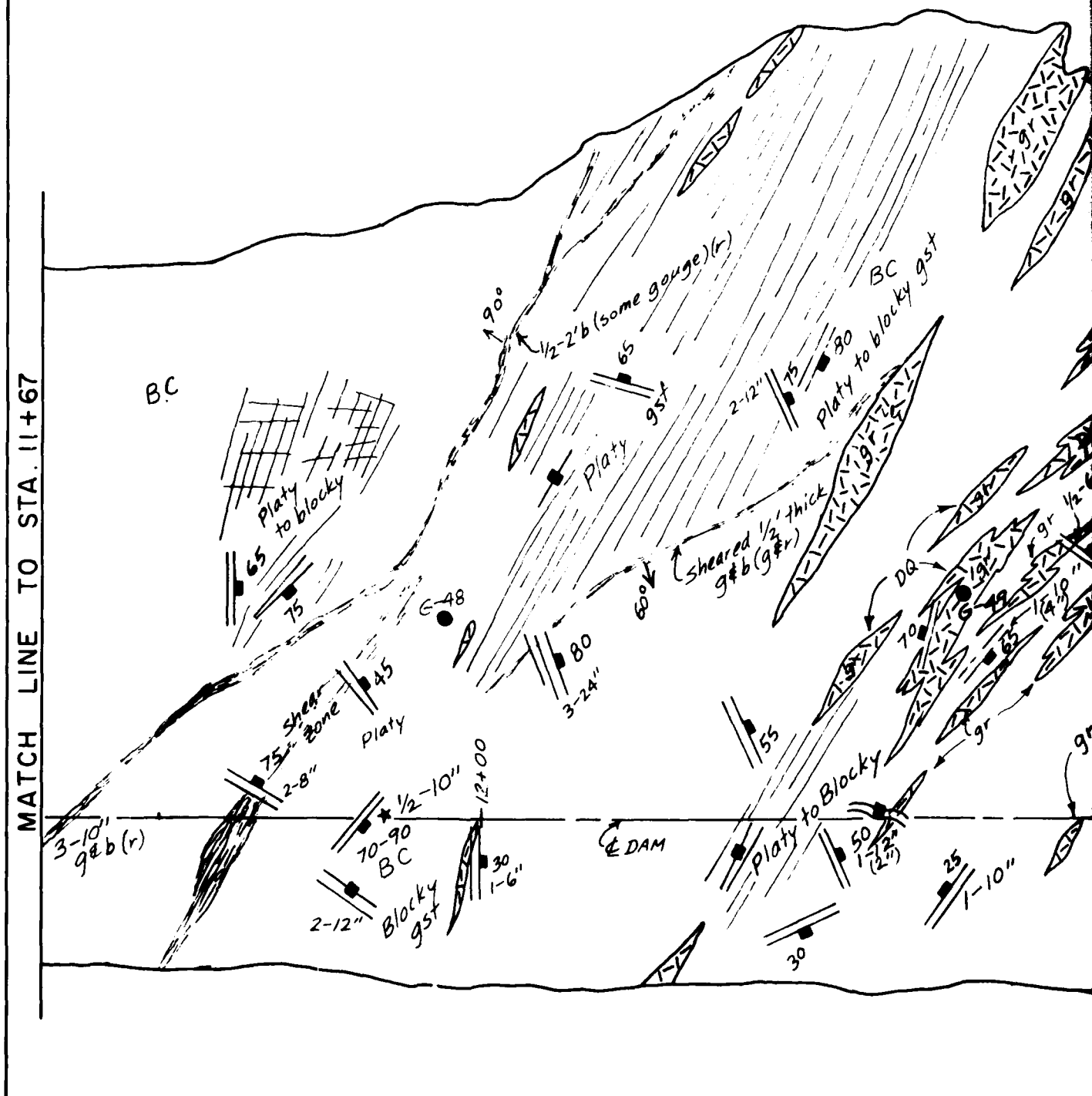
Refer to Plate 24 for Rock descriptions and explanations of symbols.

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

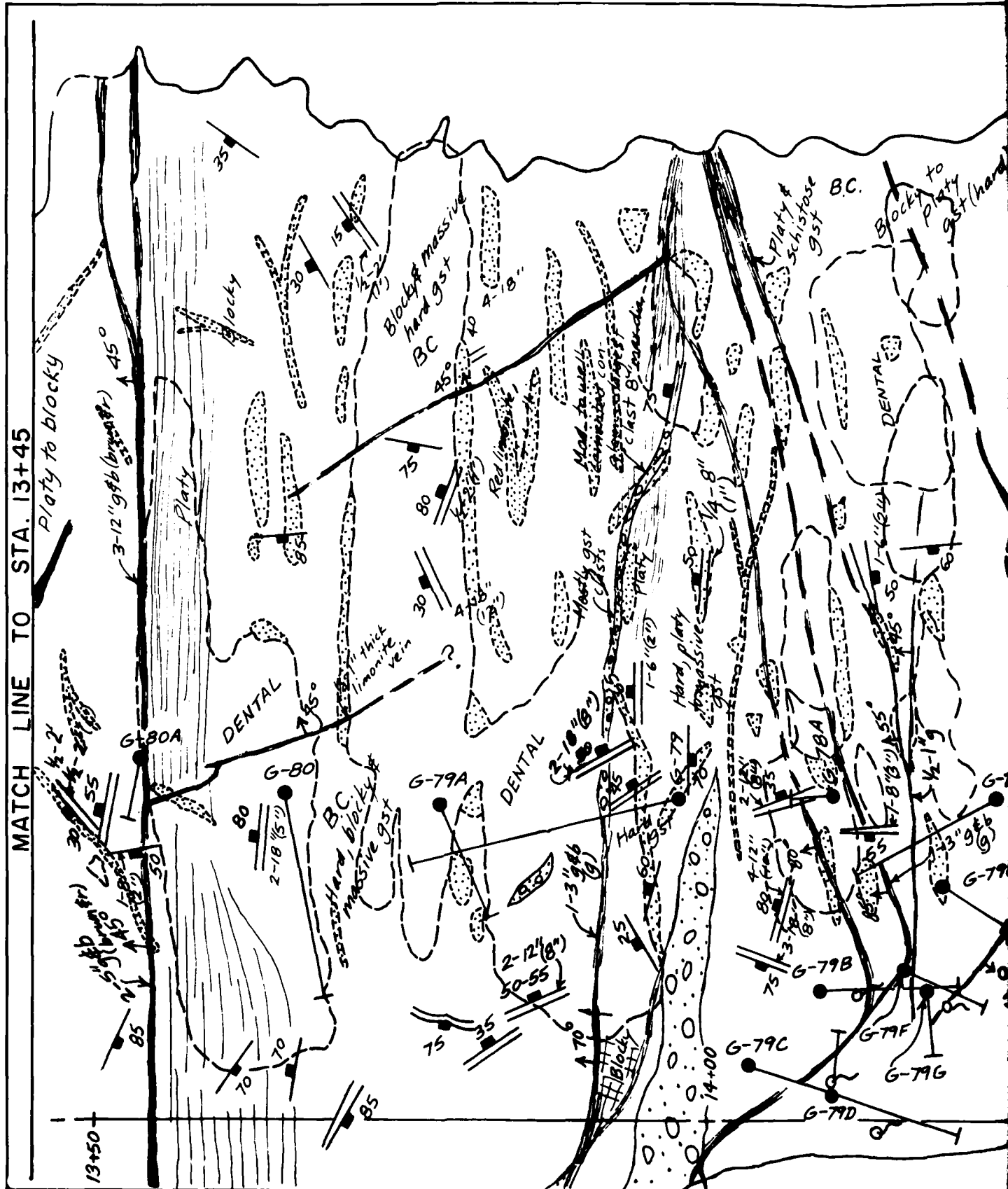
CAVE BUTTES DAM
FOUNDATION GEOLOGY
RIGHT ABUTMENT
STA. 9+79 to STA. 11+67

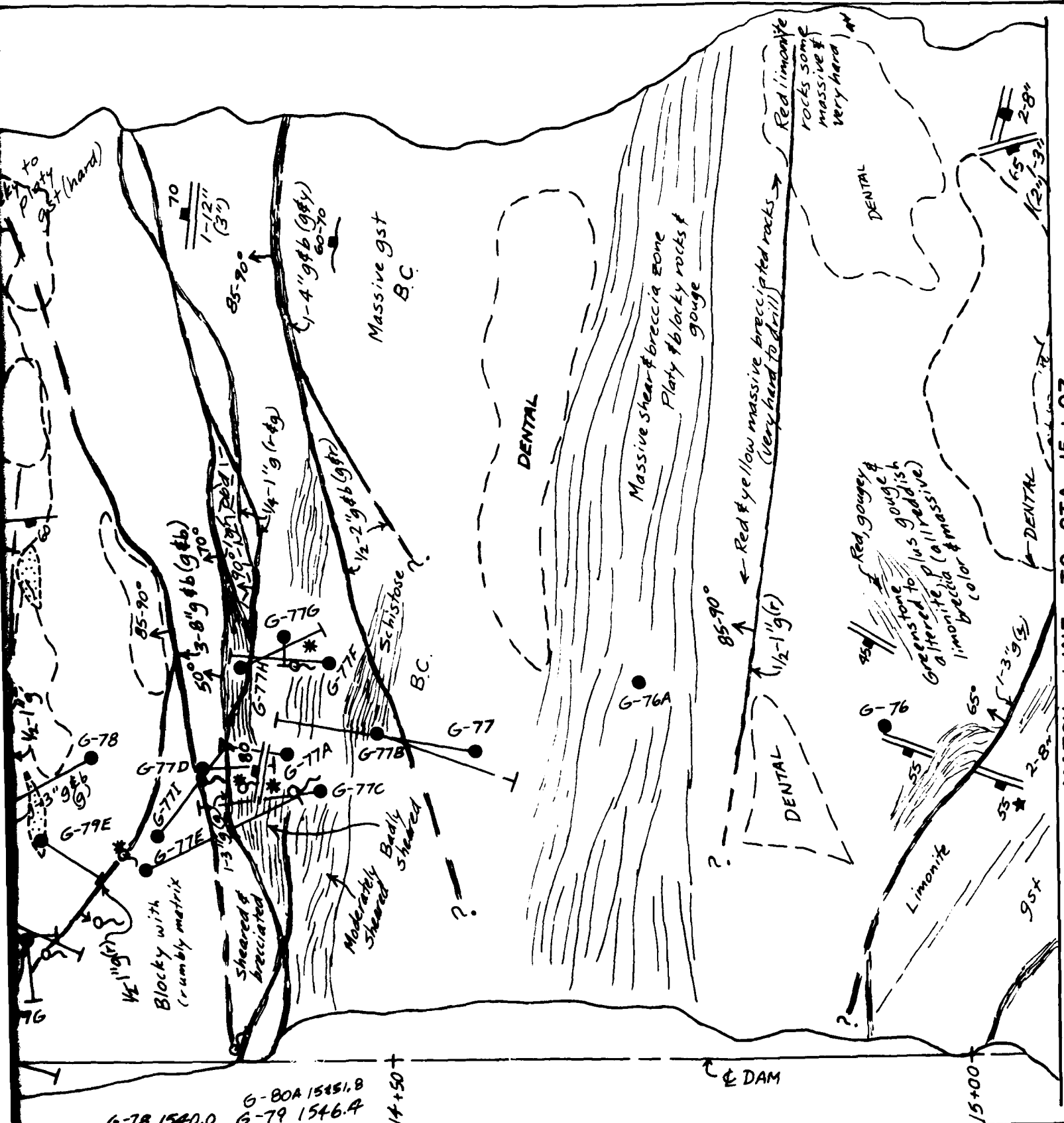
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

MATCH LINE TO STA. 11+67

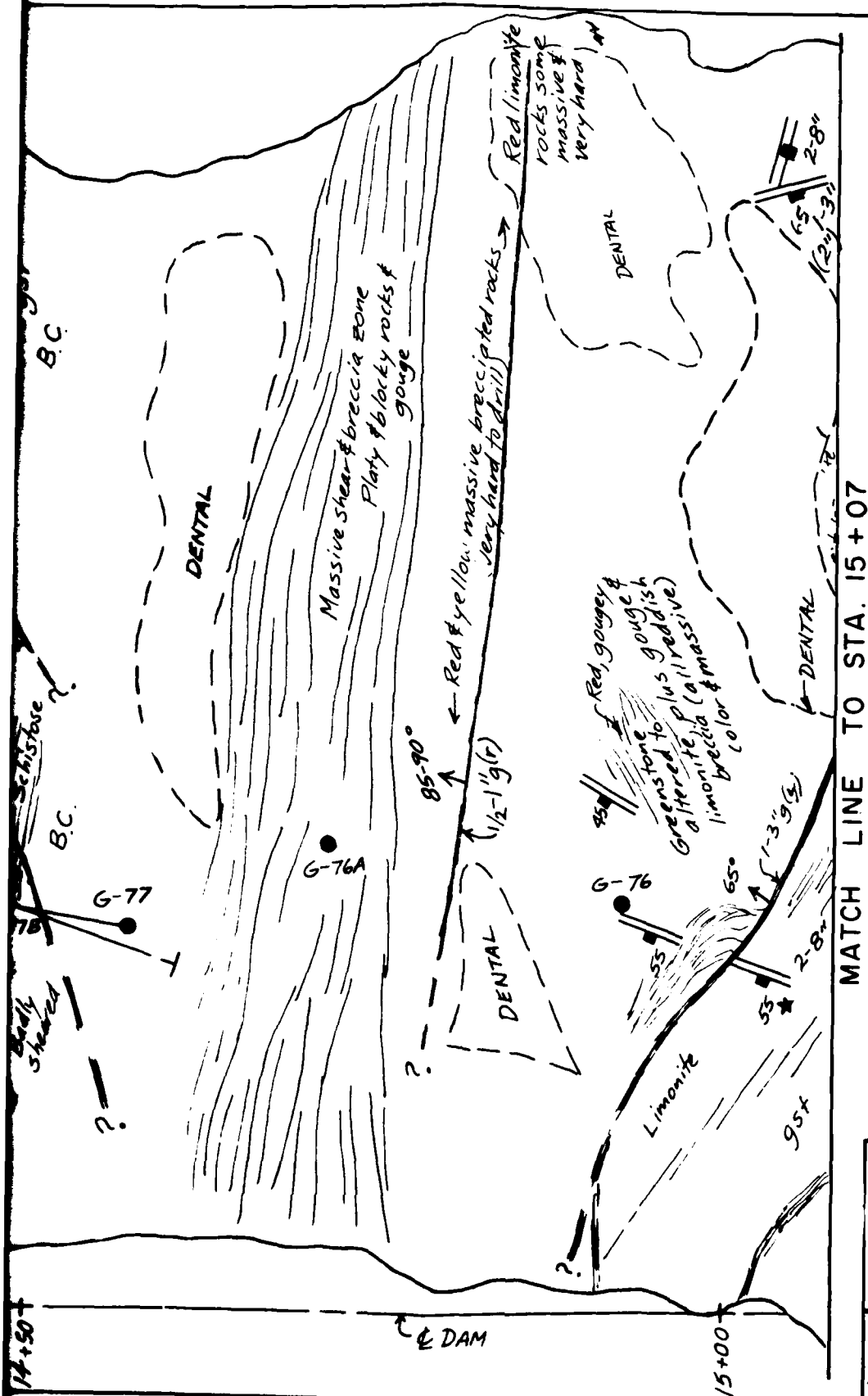


U.S. ARMY ENGINEER DISTRICT



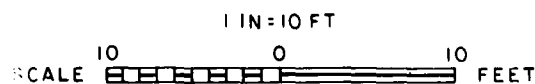


MATCH LINE TO STA. 15+07



NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols.



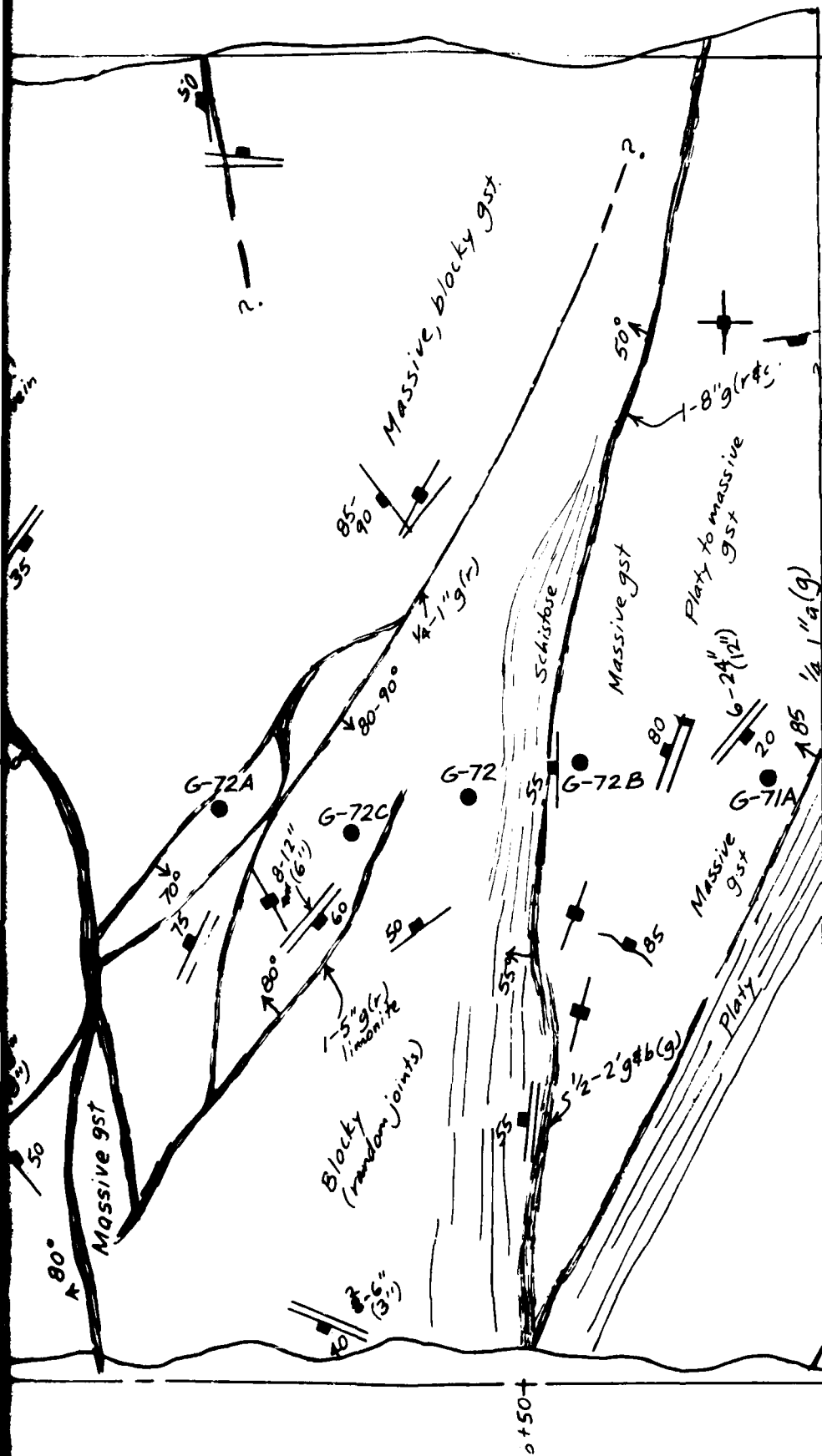
GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM
FOUNDATION GEOLOGY
CUTOFF TRENCH
STA. 13+45 to STA. 15+07

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

MATCH LINE TO STA. 15+07

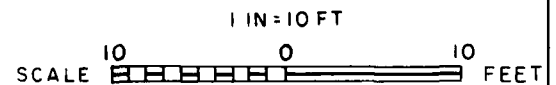




MATCH LINE TO STA. 16+71

NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols.

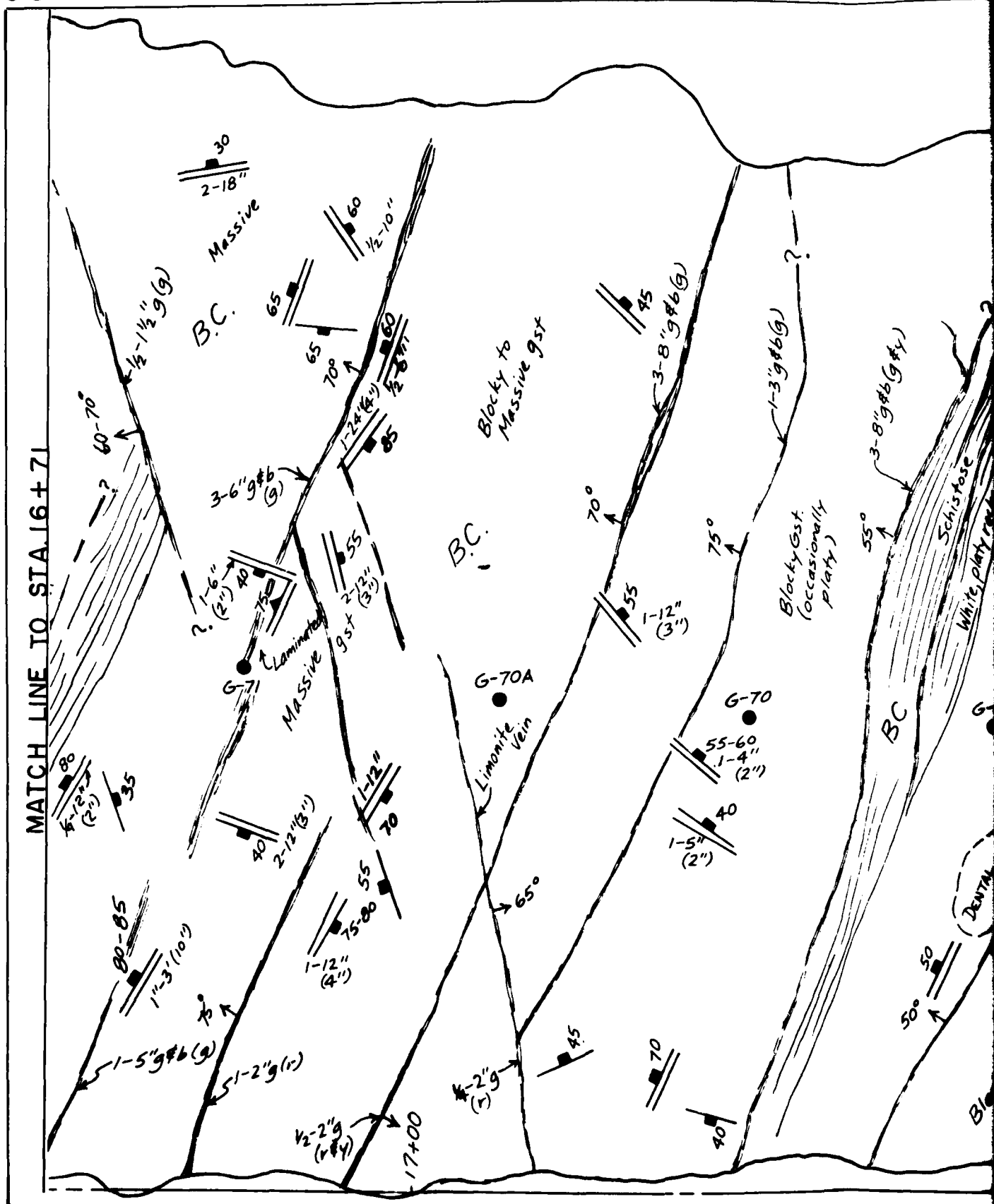


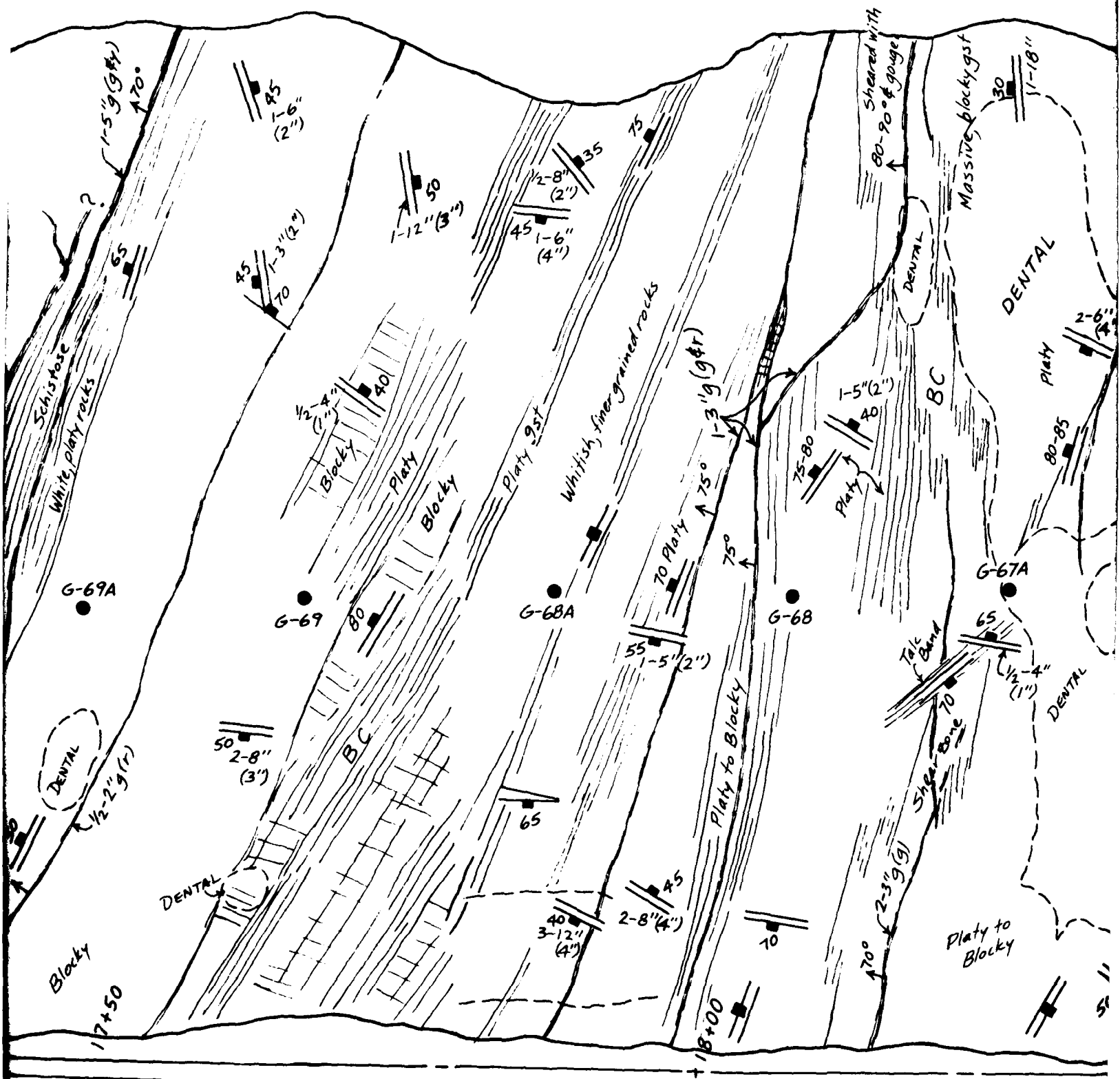
GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

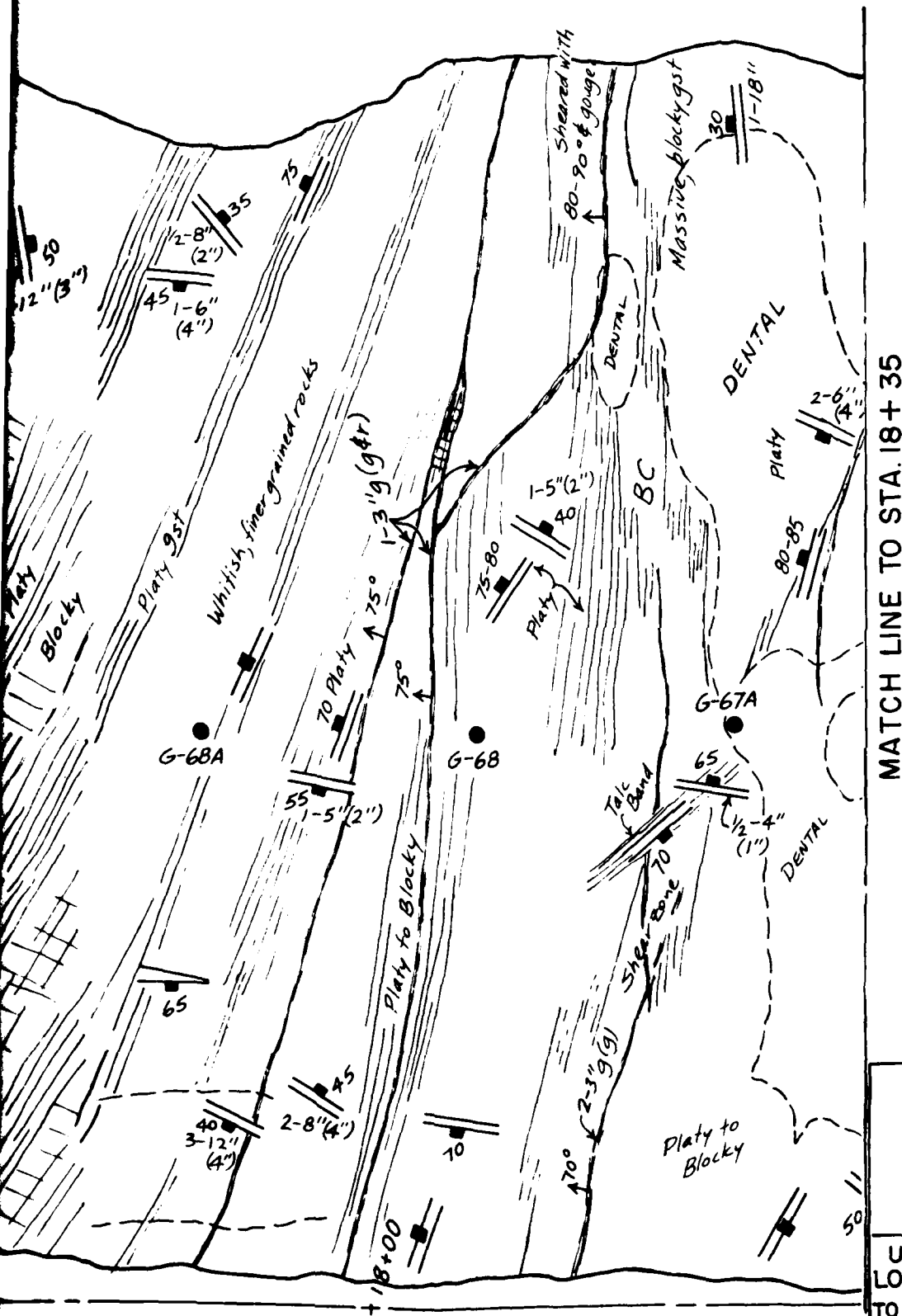
CAVE BUTTES DAM
FOUNDATION GEOLOGY
CUTOFF TRENCH
STA. 15+07 to STA. 16+71

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

U.S. ARMY ENGINEER DISTRICT

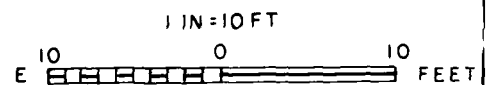






NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols.

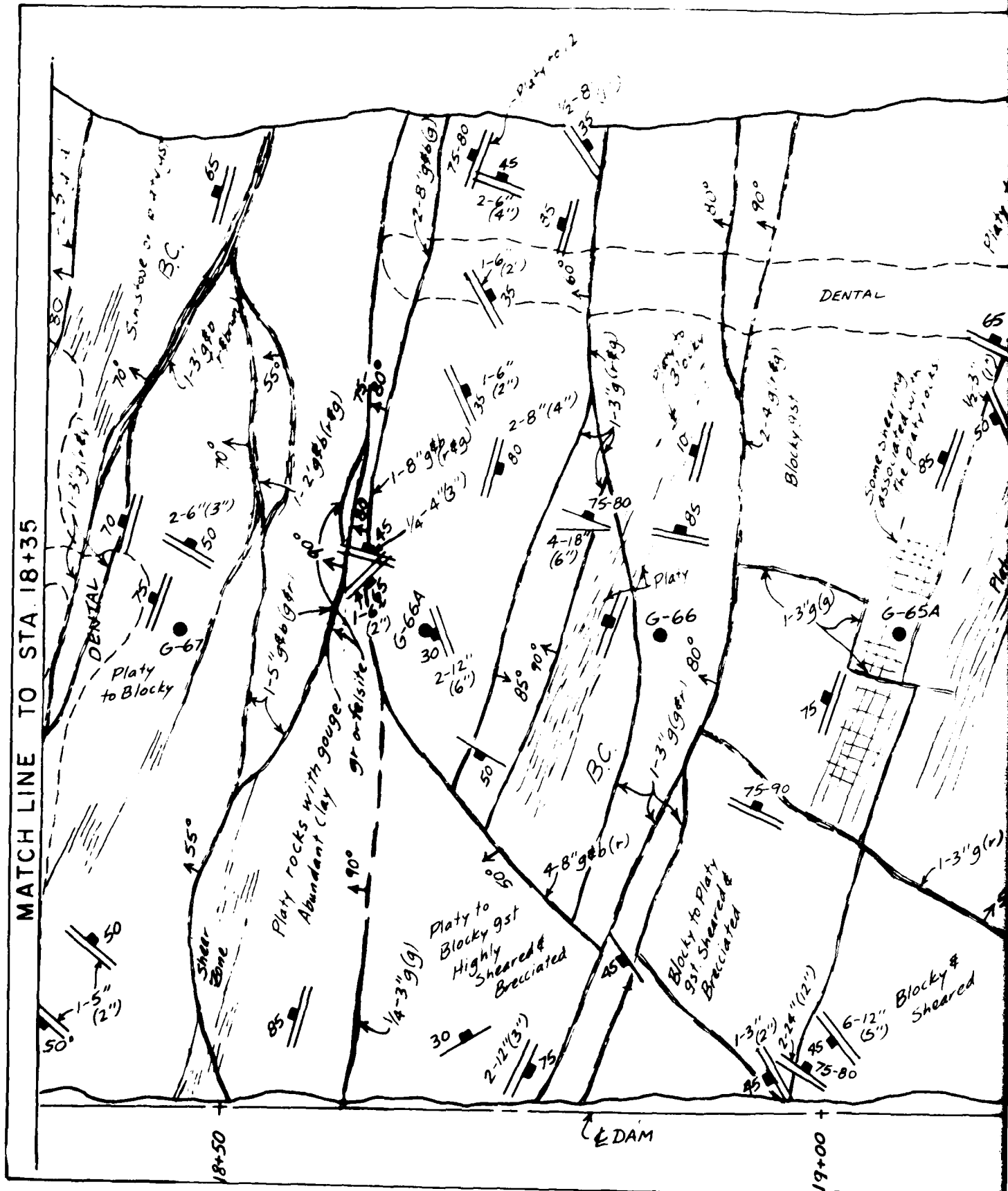


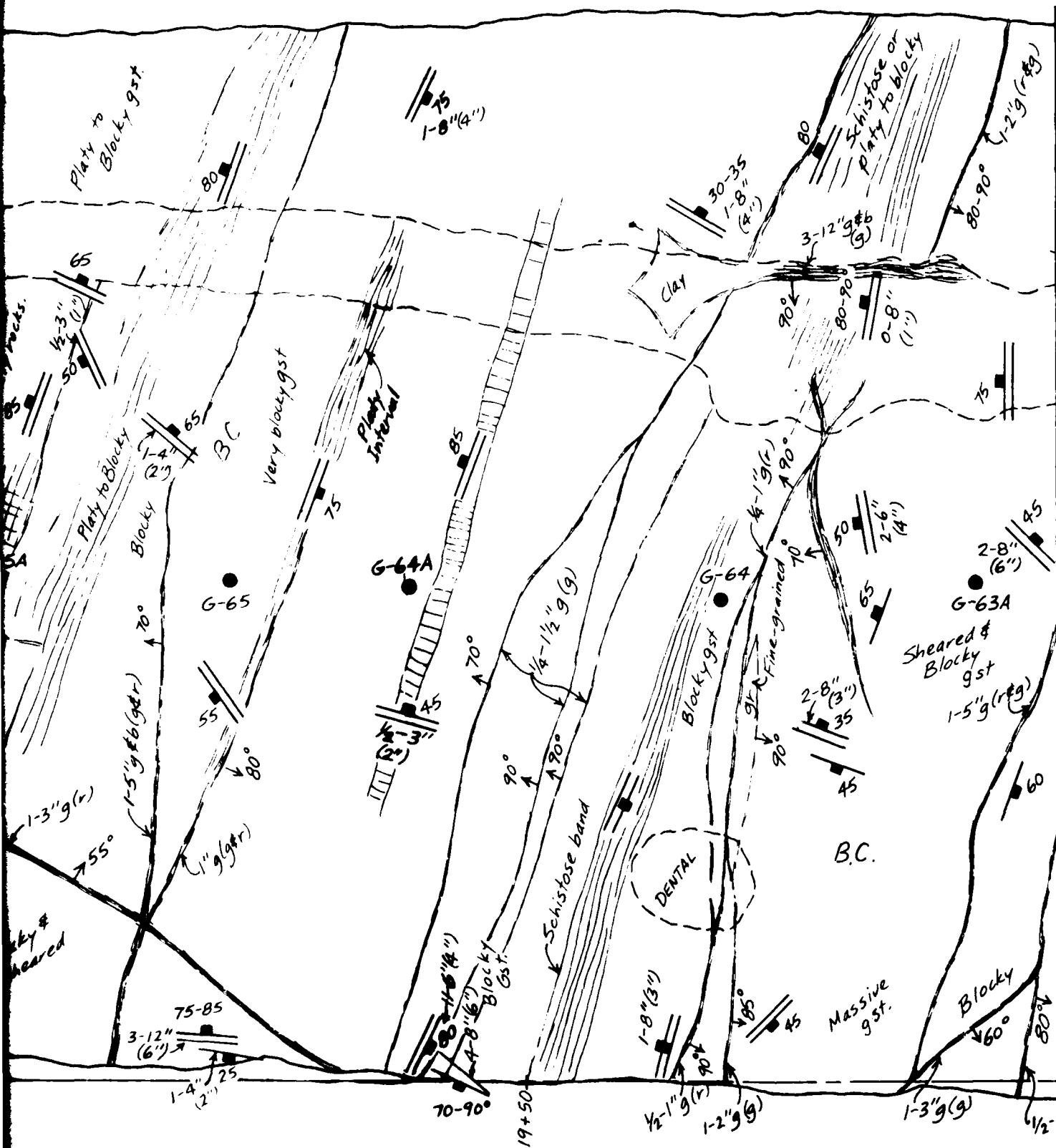
GILA RIVER BASIN
RIVER AND PHOENIX CITY STREAMS, ARIZONA

**CAVE BUTTES DAM
FOUNDATION GEOLOGY
CUTOFF TRENCH
STA. 16+71 to STA. 18+35**

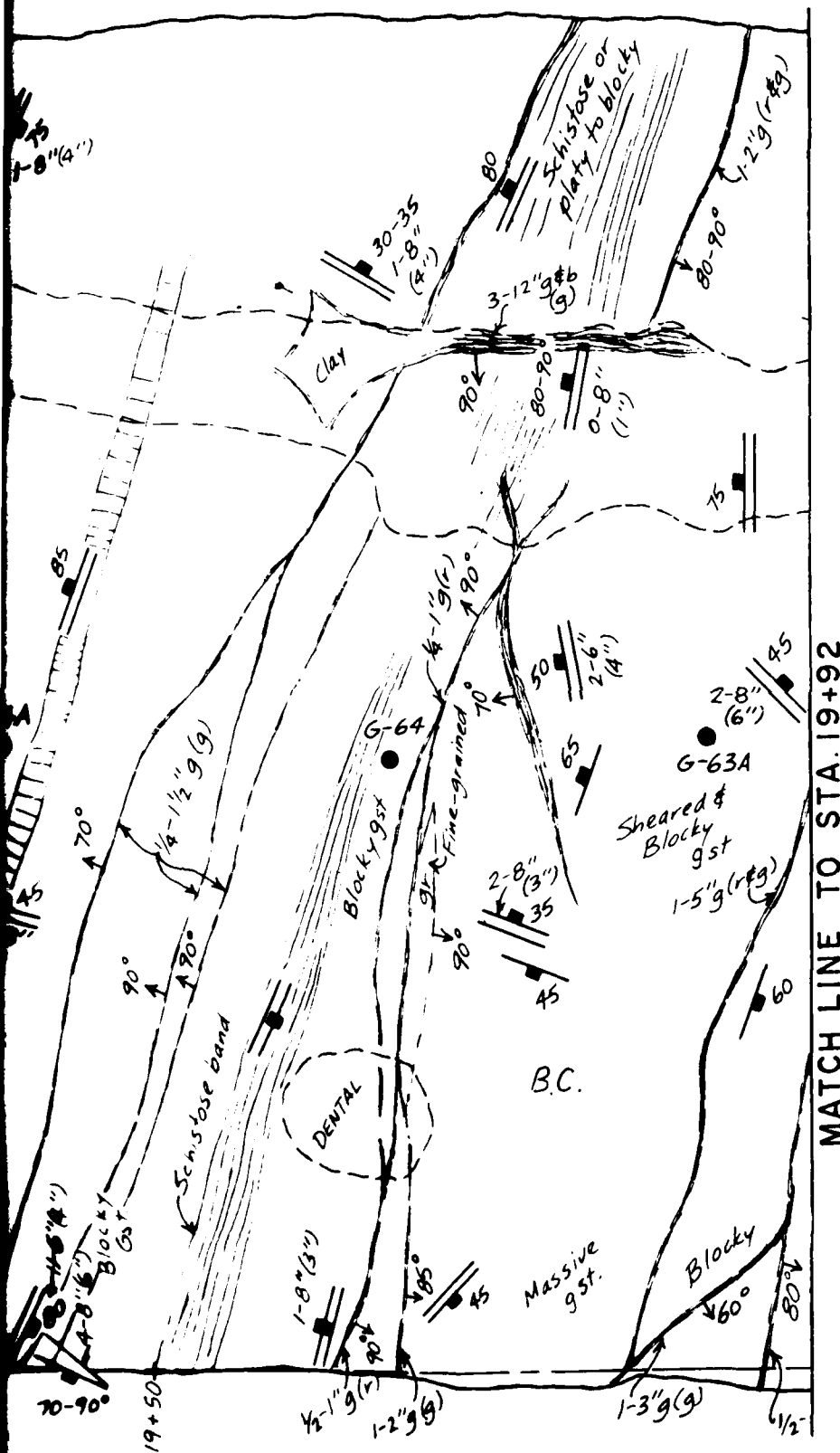
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

MATCH LINE TO STA. 18+35





MATCH LINE TO STA. 19+92



NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols.

1 IN = 10 FT
SCALE 10 0 10 FEET

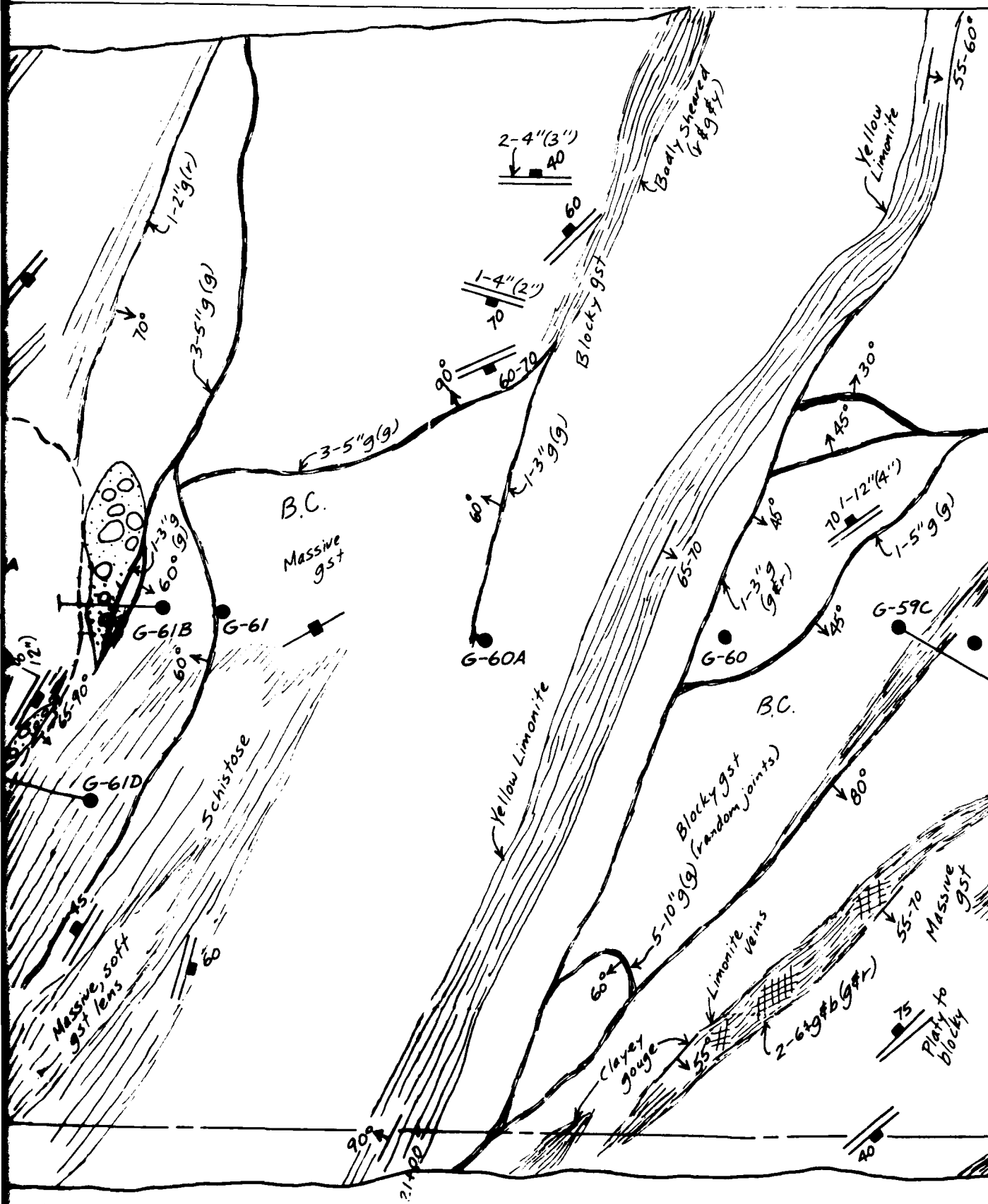
GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM
FOUNDATION GEOLOGY
CUTOFF TRENCH
STA. 18+35 to STA. 19+92

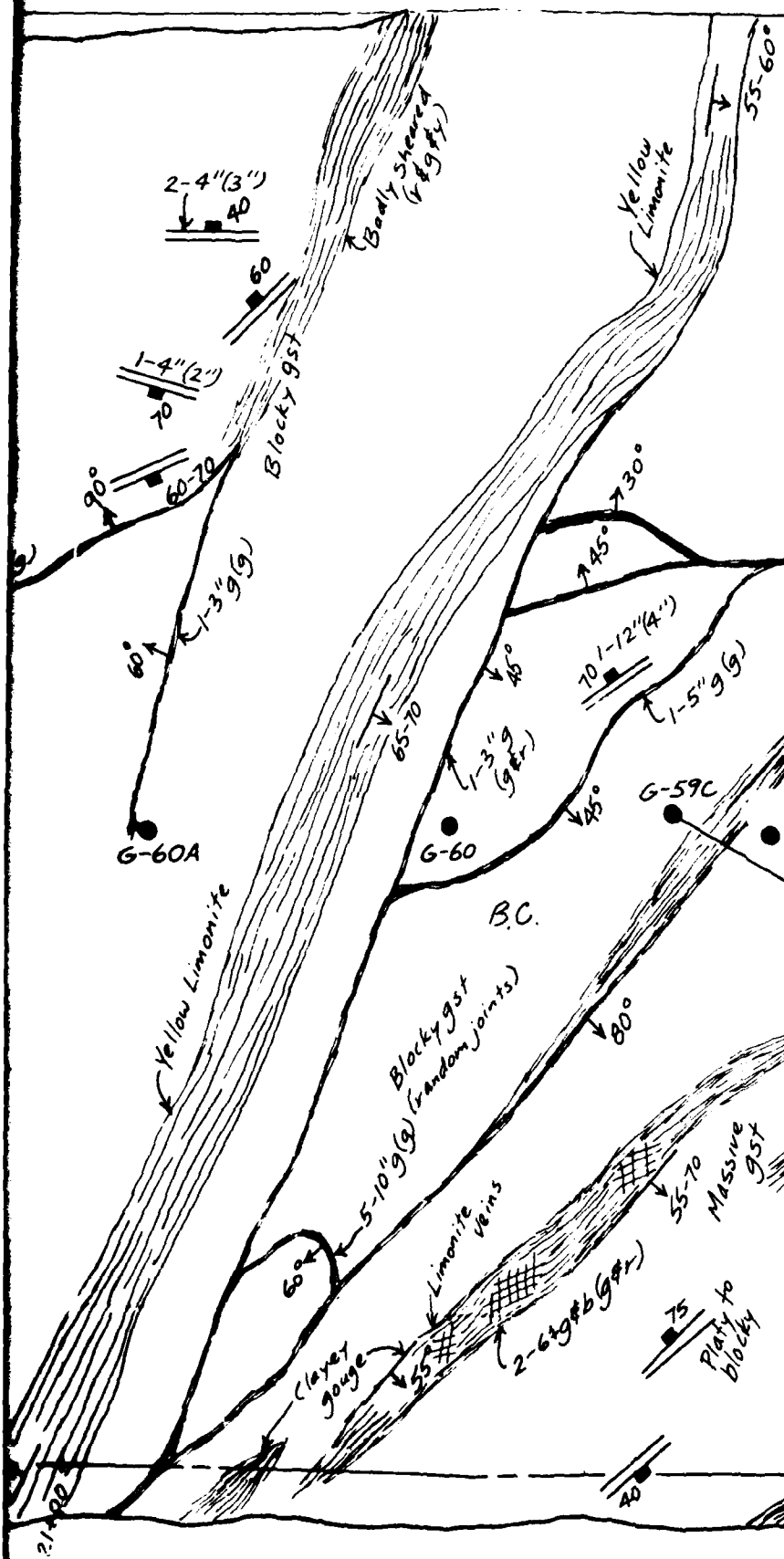
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

[illegible]

MATCH LINE TO STA. 19+92

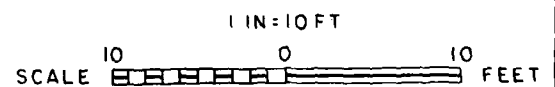


MATCH LINE TO STA. 21+47



NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols.



GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

**CAVE BUTTES DAM
FOUNDATION GEOLOGY
CUTOFF TRENCH
STA. 19+92 to STA. 21+47**

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

MATCH LINE TO STA. 21+47

Geological Features and Labels:

- Top Left:** B.C., Blocky, altered gst, 6-12" g&b (r&g), 90°, 2-5" g&b (g), 45°.
- Top Center:** Schistose, 2-3" g (g), 45°, 2-5" g (g), 35°, 45°.
- Top Right:** Clayey breccia, 50, 55, Blocky gst, 50-55°.
- Center:** Sheared gst, 1-2' Limonite g&b (r), 45°, 2-5" g (g), 30°, 1-3" g&b (g), 35°, 4-12" (5'), Platy to blocky gst, 0-1', 1-12" (3"), 25°, 1-12" 50°, 25°, 2-6" (3"), 35°, DENTAL.
- Bottom Left:** 21+50, Limonite vein, Shear zone, 50°, 30°, Serpentinized Massive, sheared with gouge, 55°, Hard, blocky area, 1-0" g&b (g&r), 40-50°, 22+00, 85°, 85°.
- Bottom Center:** B.C., 2-5" g (g&r), 40°.
- Bottom Right:** DENTAL, 1-3" g (r), Blocky to Platy highly fractured, 80°.

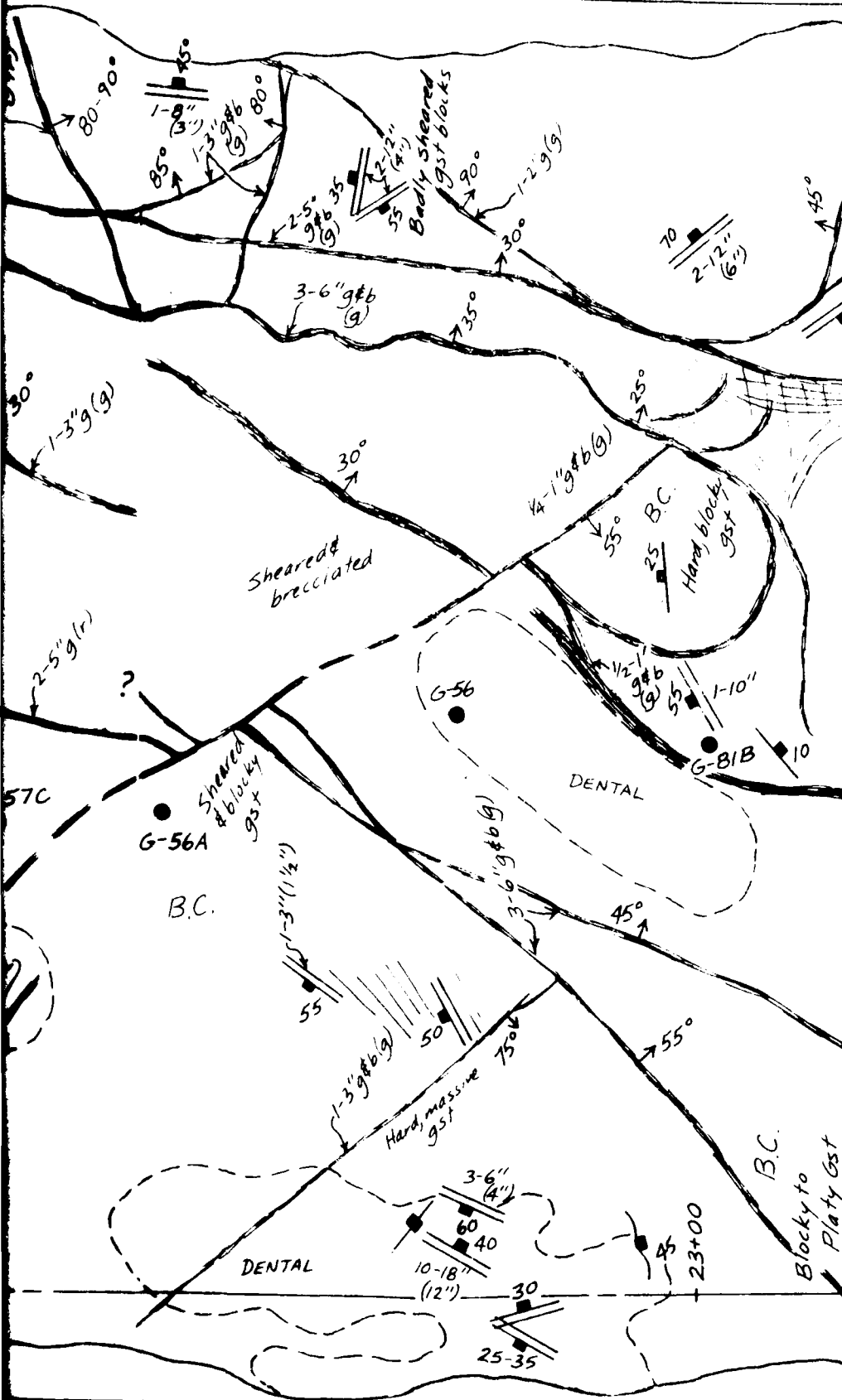
Sample Locations (G-points):

- G-59A, G-59B, G-59C, G-59D, G-59E, G-59F, G-59G, G-59H, G-58A, G-58B, G-58C, G-58D, G-58E, G-58F, G-58G, G-57B.

Structural Data:

- Angles: 90°, 45°, 35°, 30°, 50-55°, 25°, 35°, 50°, 40°, 50°, 85°, 80°.
- Distances: 21+50, 22+00.
- Other: 7A, 70', 1-3" (2'), 1-3' thick, 1-0" g&b (g&r), 40-50°.

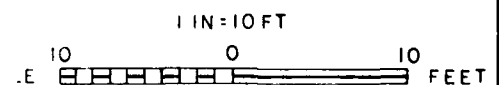
MATCH LINE TO STA. 21+47



MATCH LINE TO STA. 23+11

NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols.

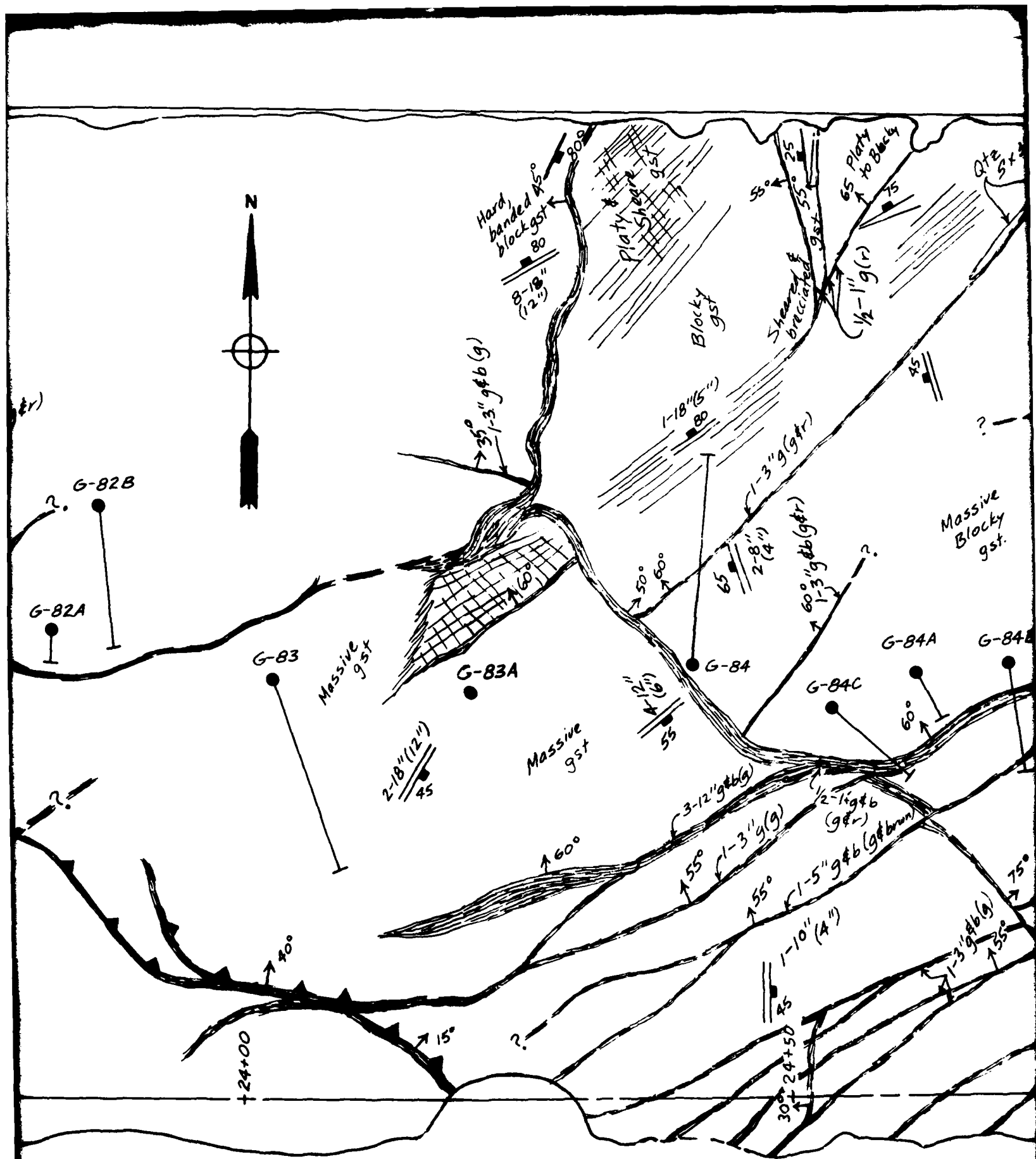


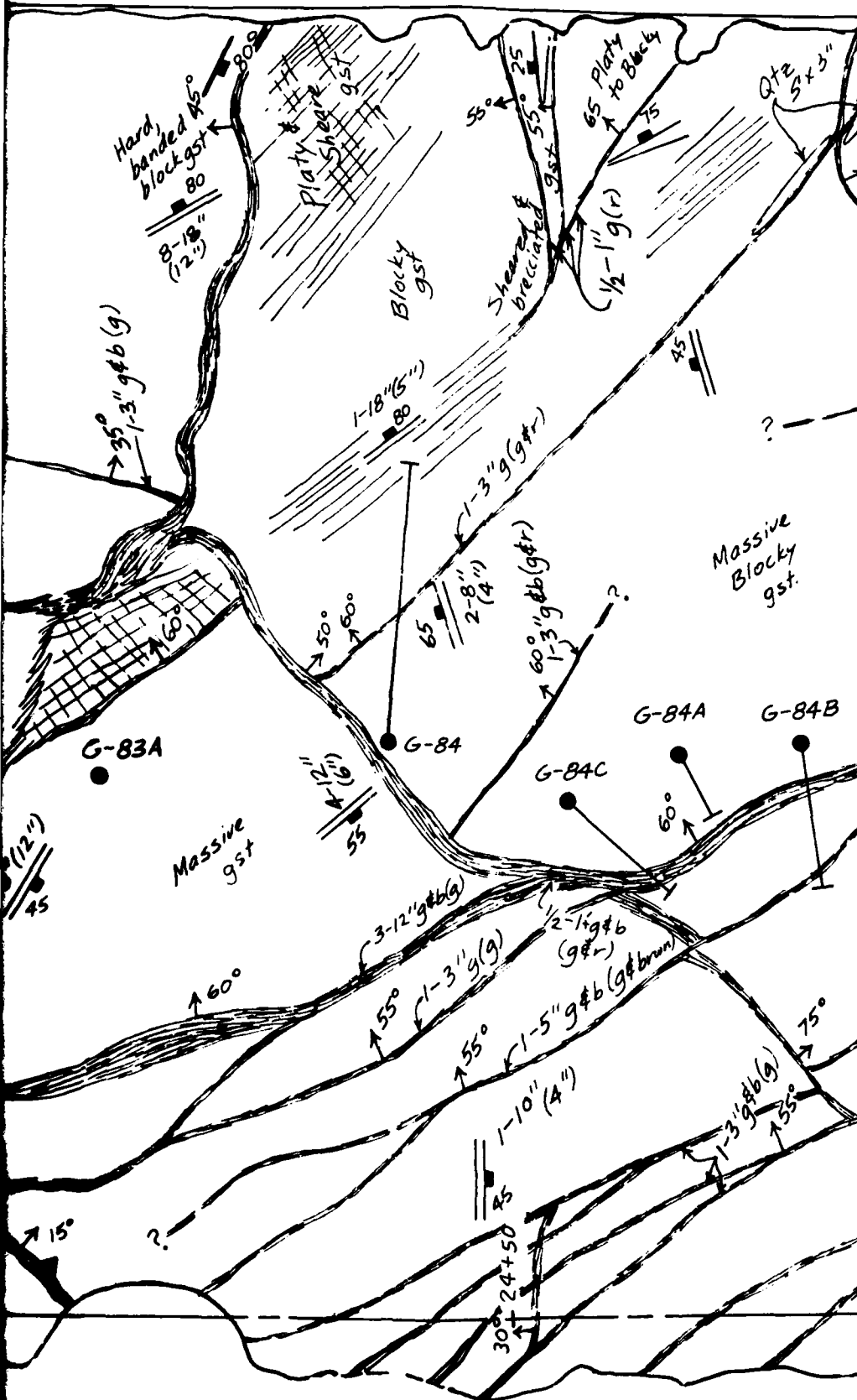
GILA RIVER BASIN
 RIVER AND PHOENIX CITY STREAMS, ARIZONA

**CAVE BUTTES DAM
 FOUNDATION GEOLOGY
 CUTOFF TRENCH
 STA. 21+47 to STA. 23+11**

U.S. ARMY ENGINEER DISTRICT
 LOS ANGELES, CORPS OF ENGINEERS
 TO ACCOMPANY REPORT DATED:

[illegible]





MATCH LINE TO STA. 24+75

NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols.

1 IN = 10 FT

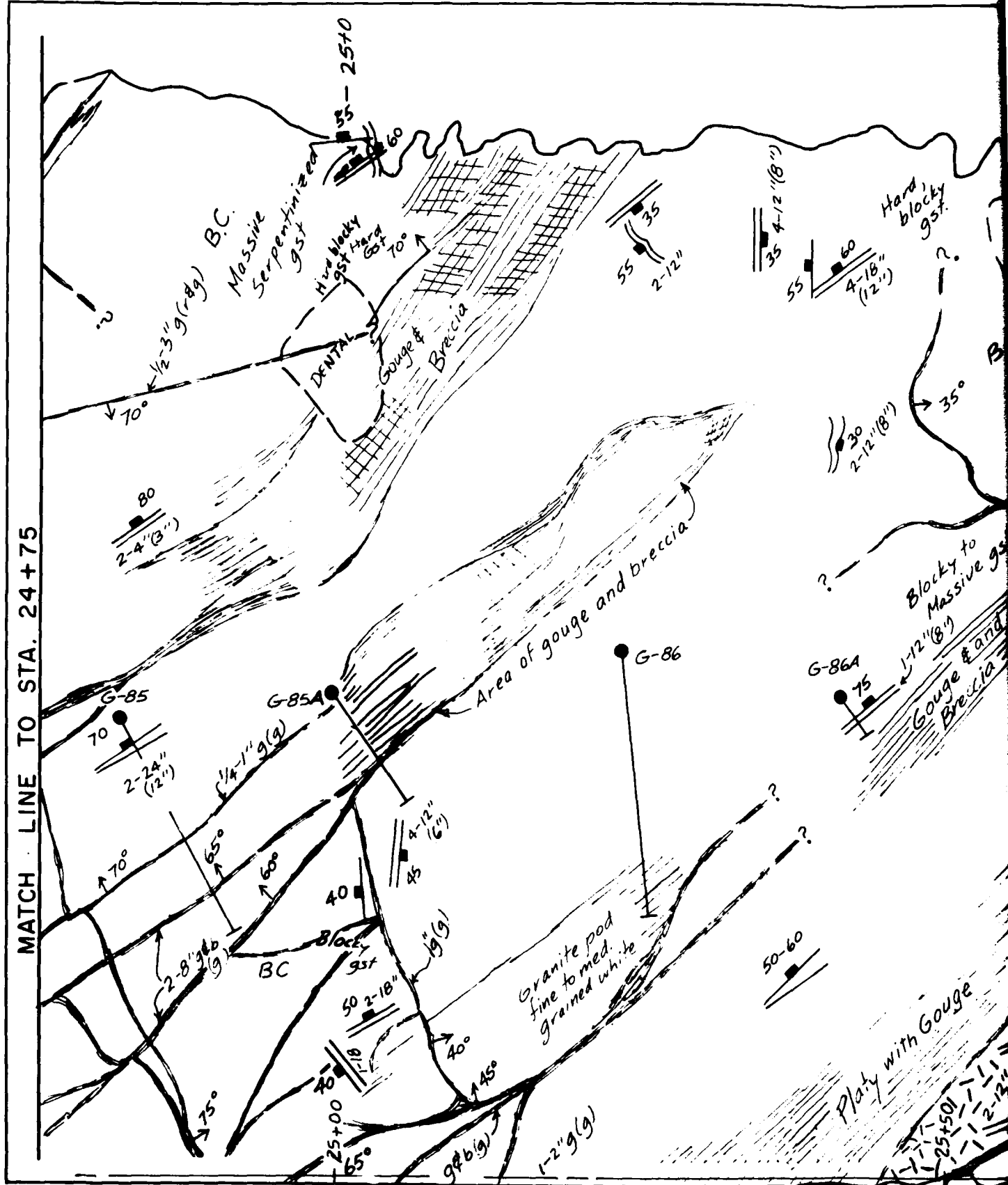
10 0 10 FEET

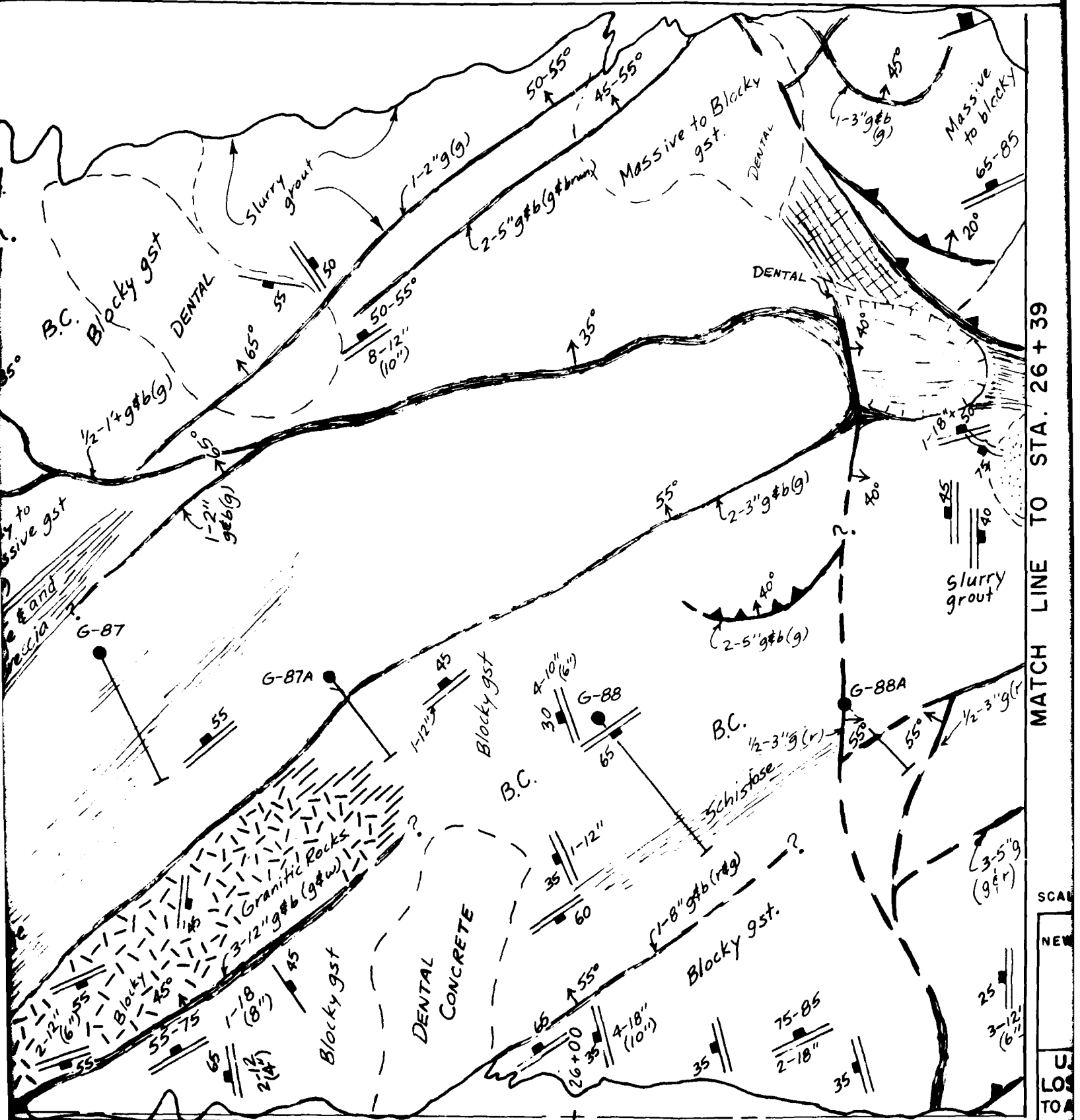
GILA RIVER BASIN
W RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM
FOUNDATION GEOLOGY
CUTOFF TRENCH
STA. 23+11 to STA. 24+75

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

U.S. ARMY ENGINEER DISTRICT





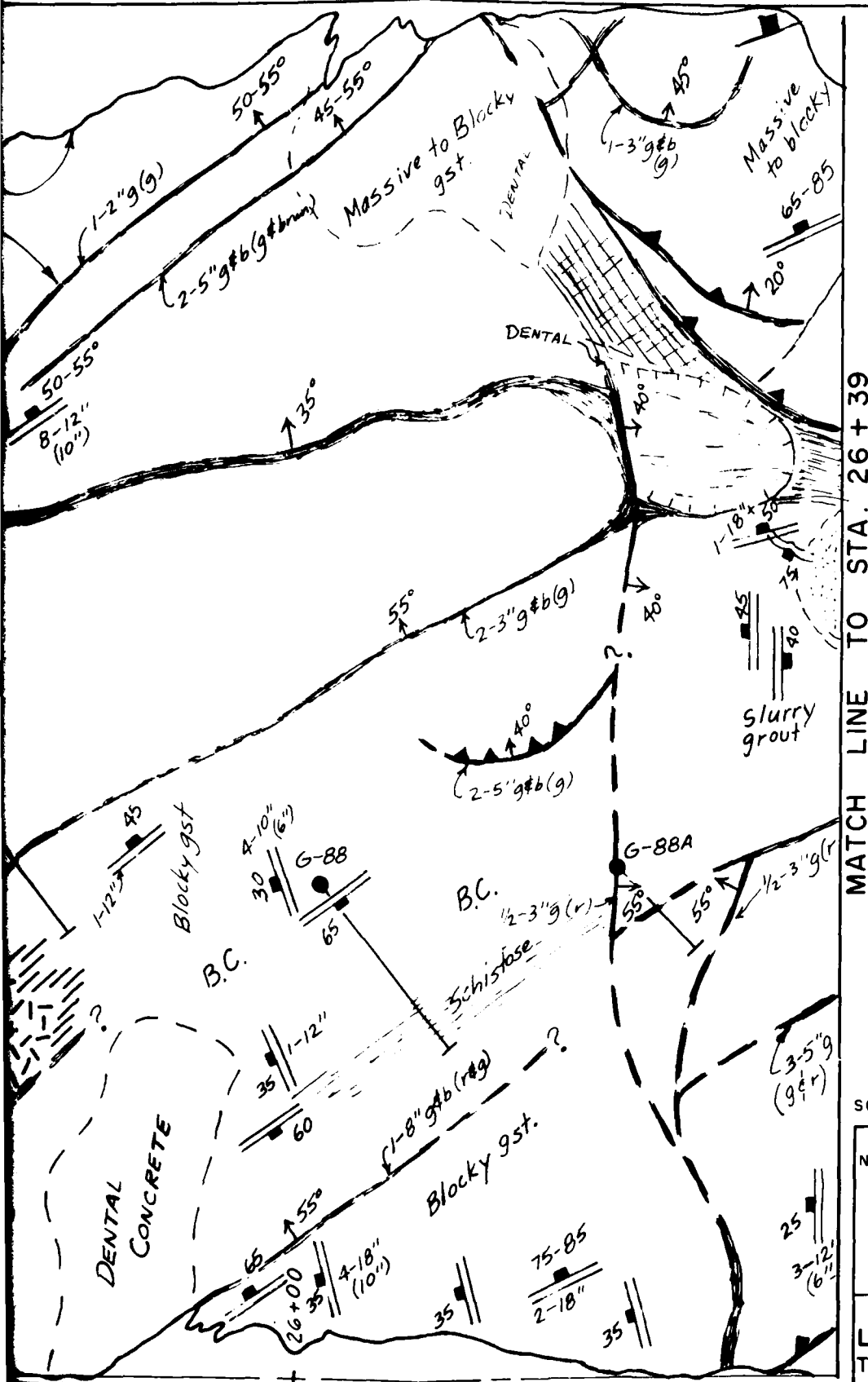
MATCH LINE TO STA. 26 + 39

SCALE

NEW

U.
LOS
TOA

FOUNDA



NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols.

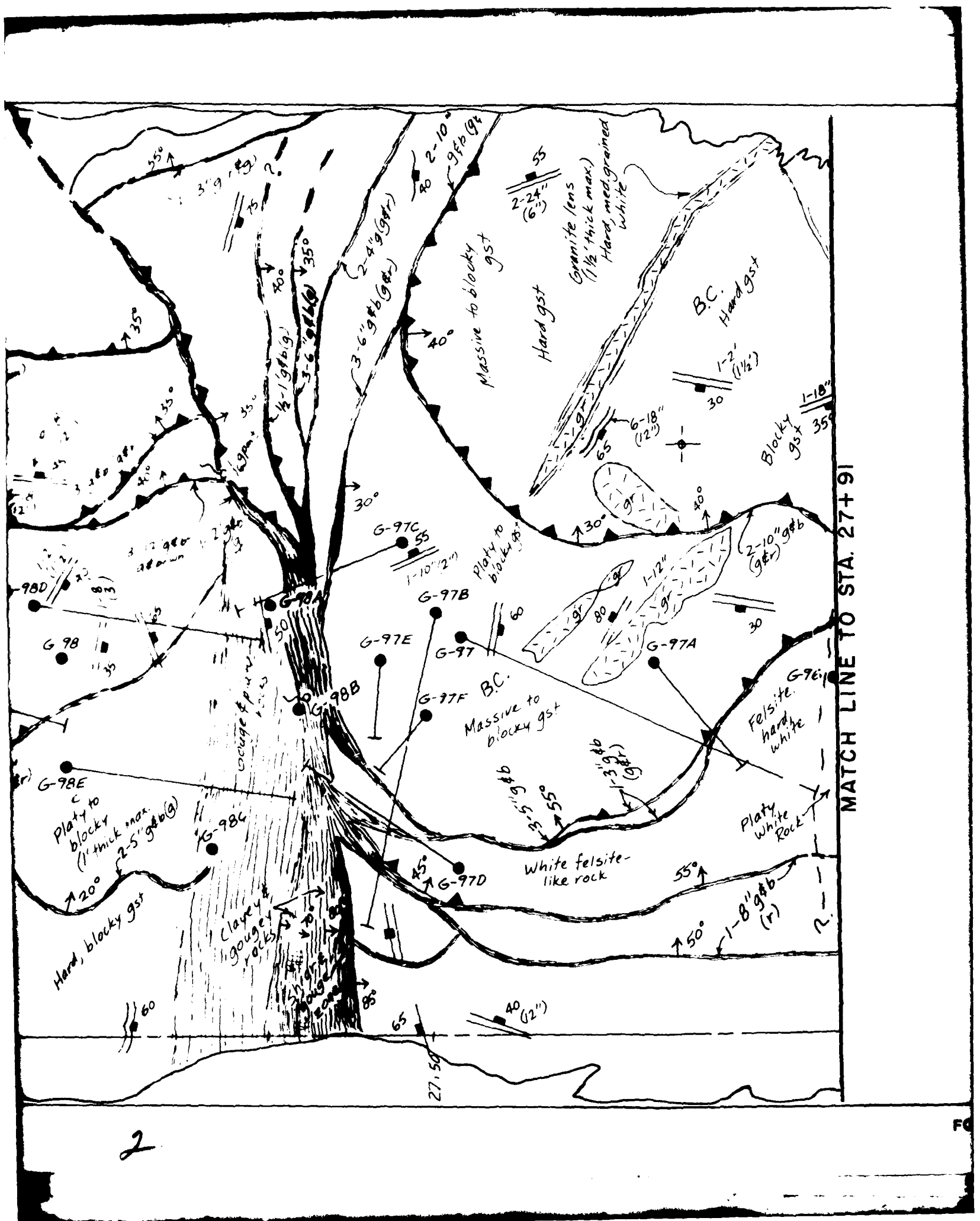
1 IN = 10 FT

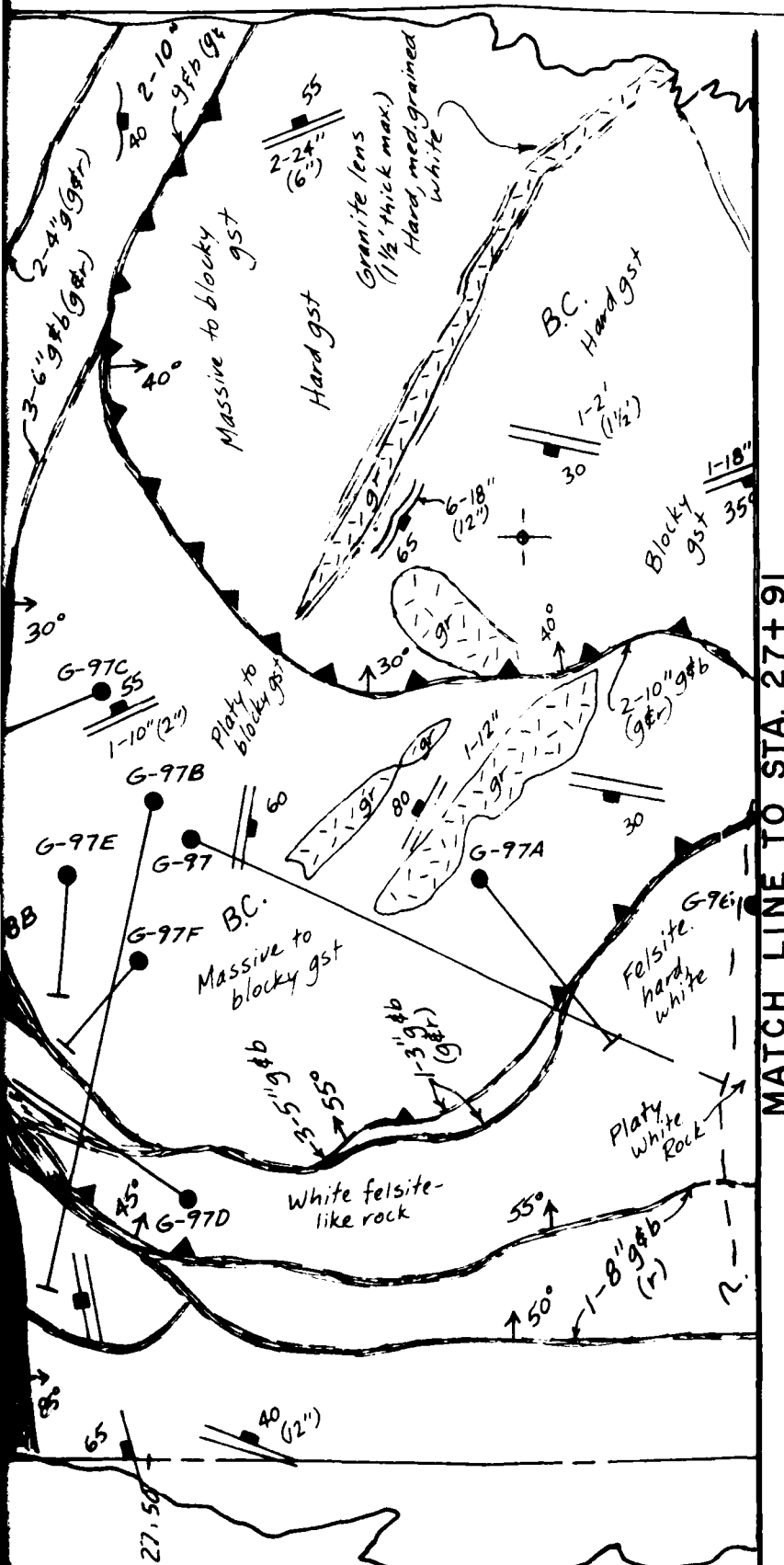
SCALE 0 10 FEET

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM
FOUNDATION GEOLOGY
CUTOFF TRENCH
STA. 24+75 to STA. 26+39

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:





NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols.

1 IN = 10 FT

SCALE 10 0 10 FEET

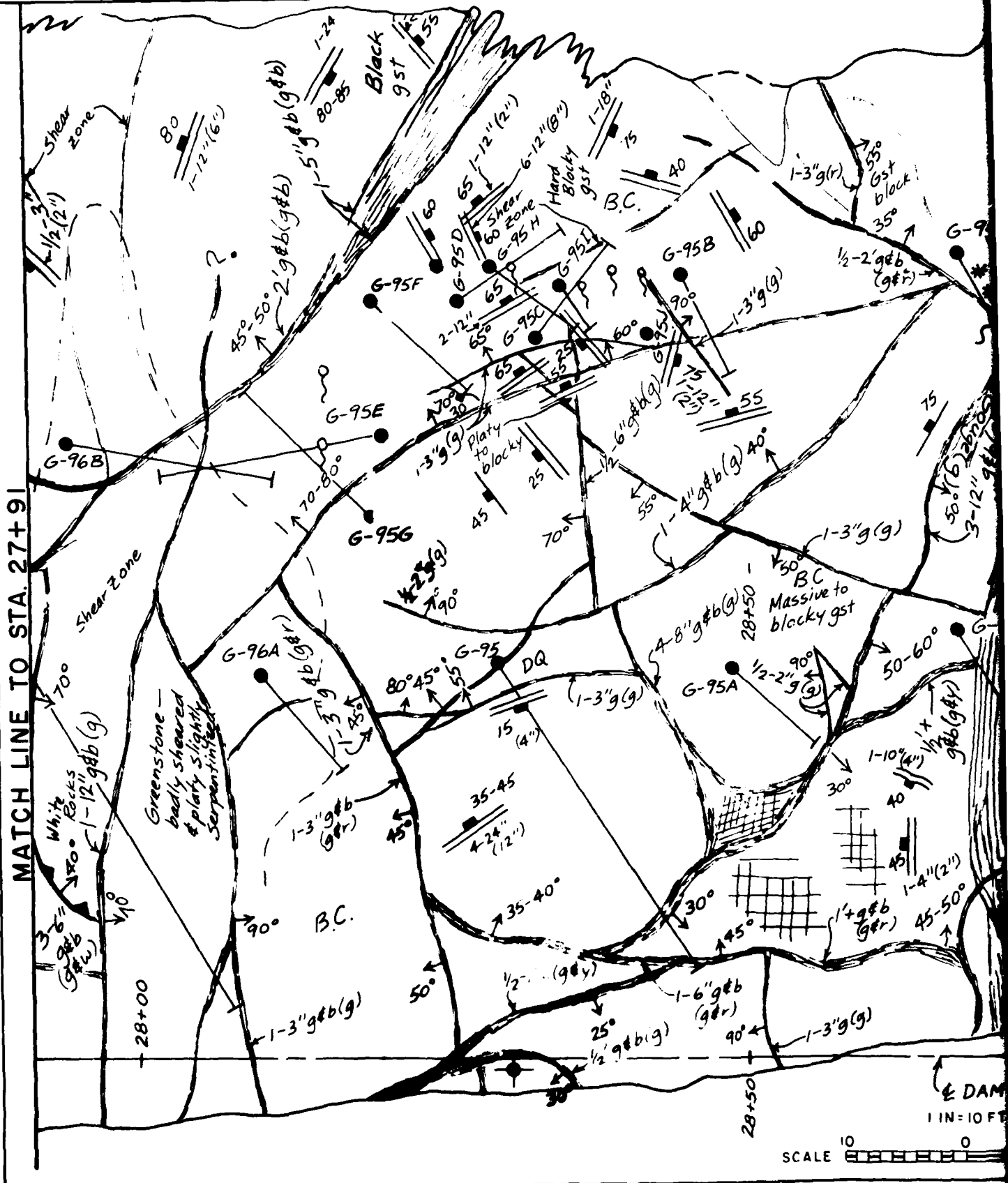
GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

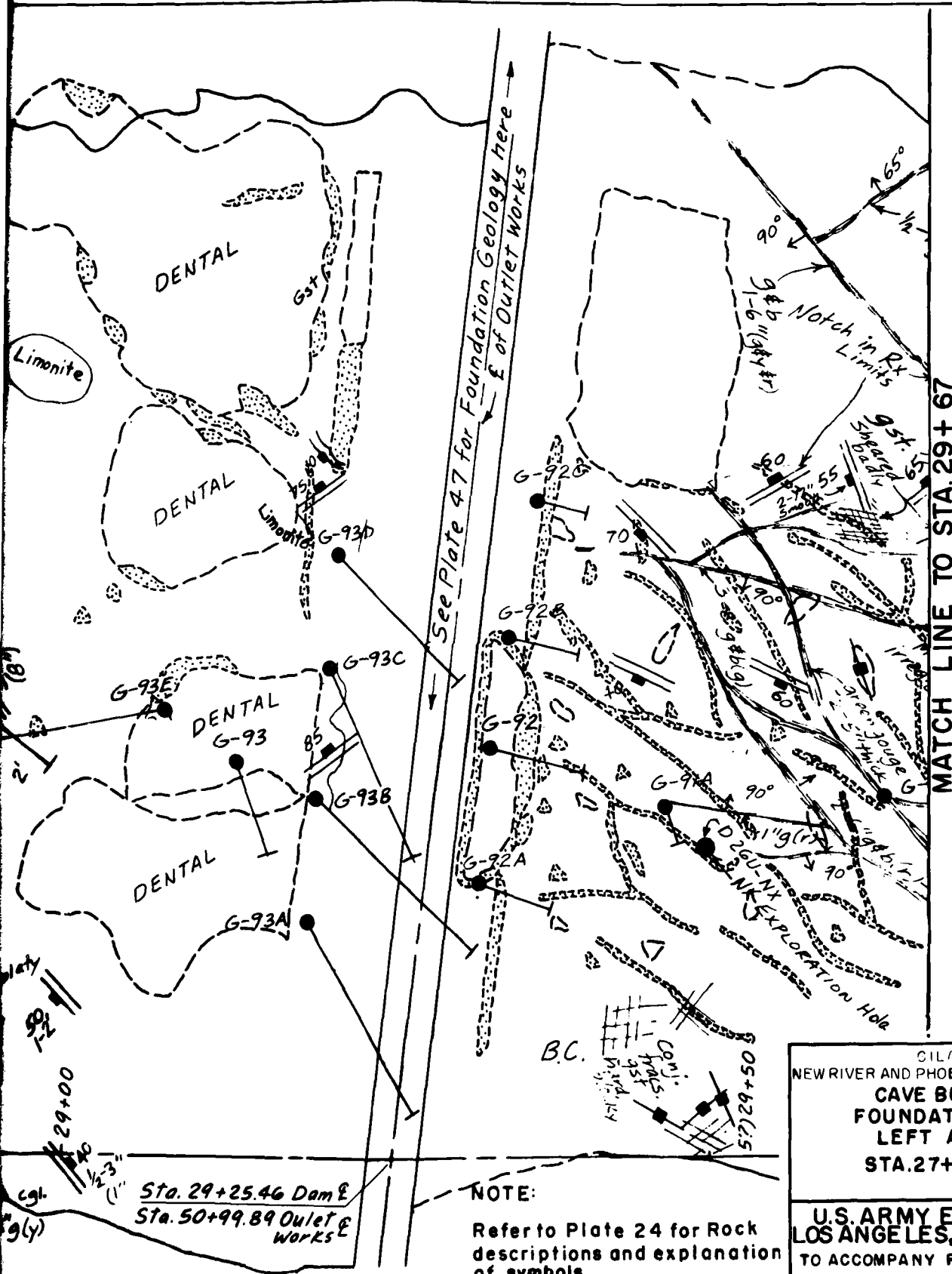
CAVE BUTTES DAM
FOUNDATION GEOLOGY
CUTOFF TRENCH
STA. 26+39 to STA. 27+91

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

U.S. ARMY ENGINEER DISTRICT

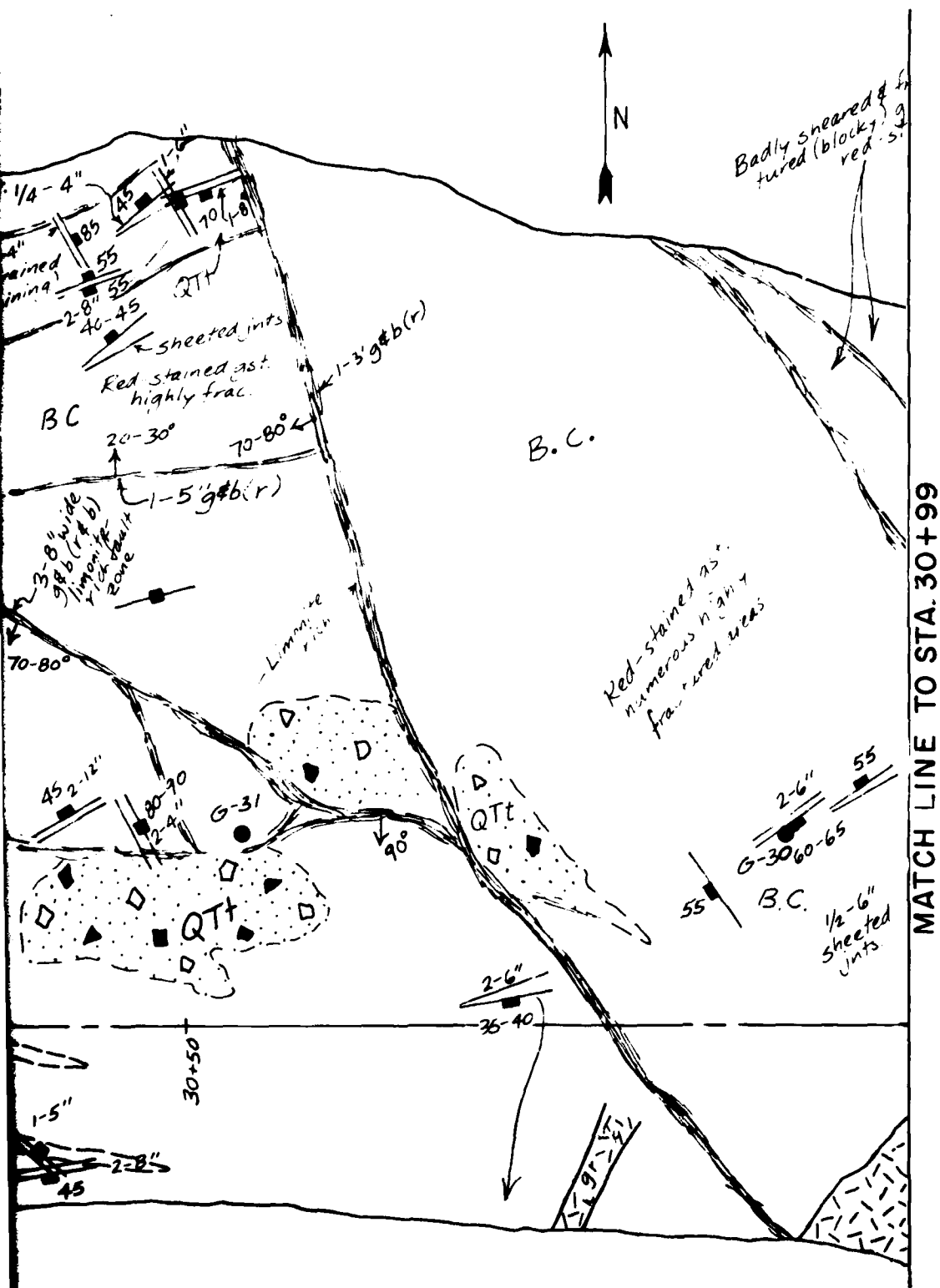
MATCH LINE TO STA. 27+91





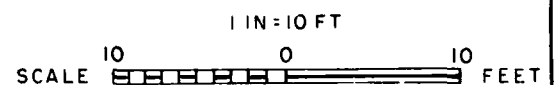
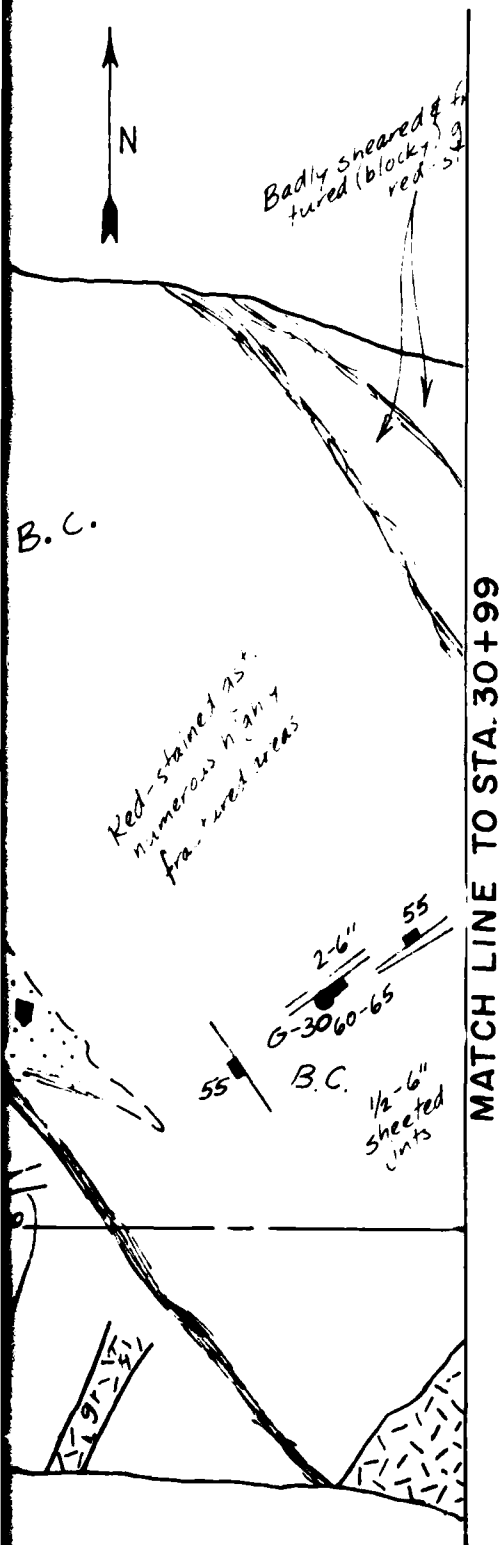
GILF. RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA
CAVE BUTTES DAM
FOUNDATION GEOLOGY
LEFT ABUTMENT
STA. 27+91 to STA. 29+67

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:



NOTE:

Refer to Plate 24 for Rock descriptions and explanation of symbols.



NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols.

GILA RIVER BASIN
 NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA
CAVE BUTTES DAM
FOUNDATION GEOLOGY
LEFT ABUTMENT
STA. 29+67 to STA. 30+99
 U.S. ARMY ENGINEER DISTRICT
 LOS ANGELES, CORPS OF ENGINEERS
 TO ACCOMPANY REPORT DATED:

MATCH LINE TO STA. 30+99

40

80

B.C.

Schistose

g

55

Schistose with gouge

45

1-12"

75

65

2-5"

6-28

2-12"

55

60

45

65

Shear

Badly sheared altered gst (red-stained)

60

31+50

45

1-2" g(r)

1/2-2" g(r)

31+00

30

60

55

2-8"

60

2-6"

Elevated gst block

B.C.

Blocky red-stained gst.

2-6"

35

DAM

6-29

9a

6-30

6-31

6-32

6-33

6-34

6-35

6-36

6-37

6-38

6-39

6-40

6-41

6-42

6-43

6-44

6-45

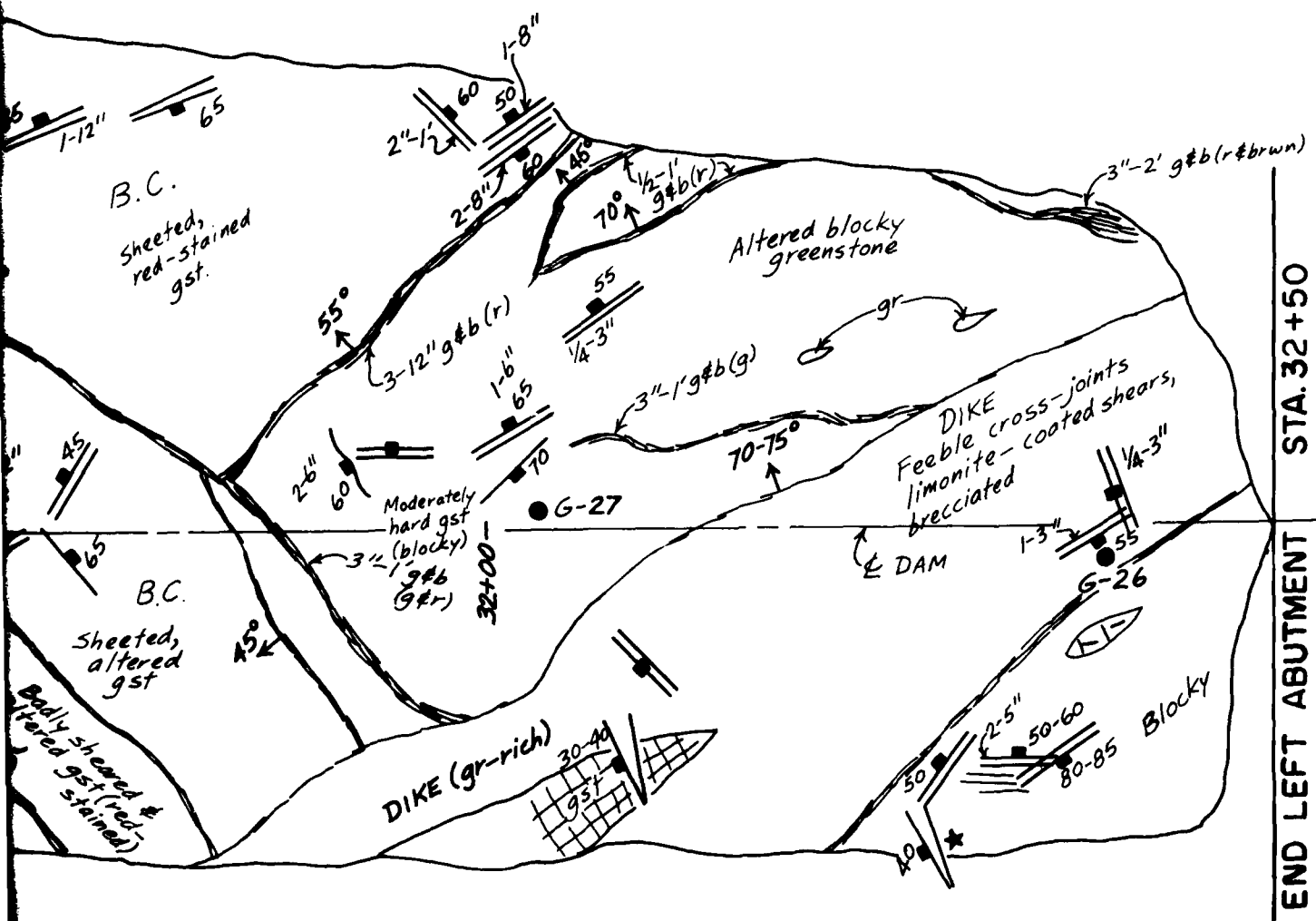
6-46

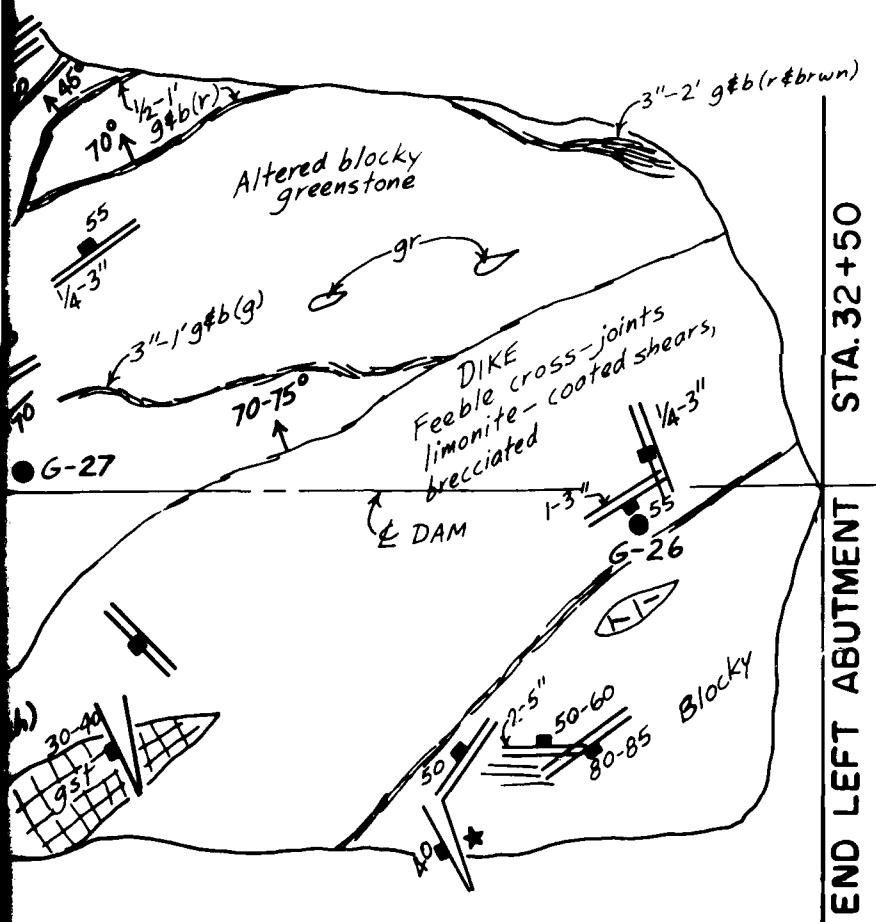
6-47

6-48

6-49

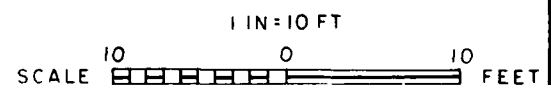
6-50





NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols.



GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

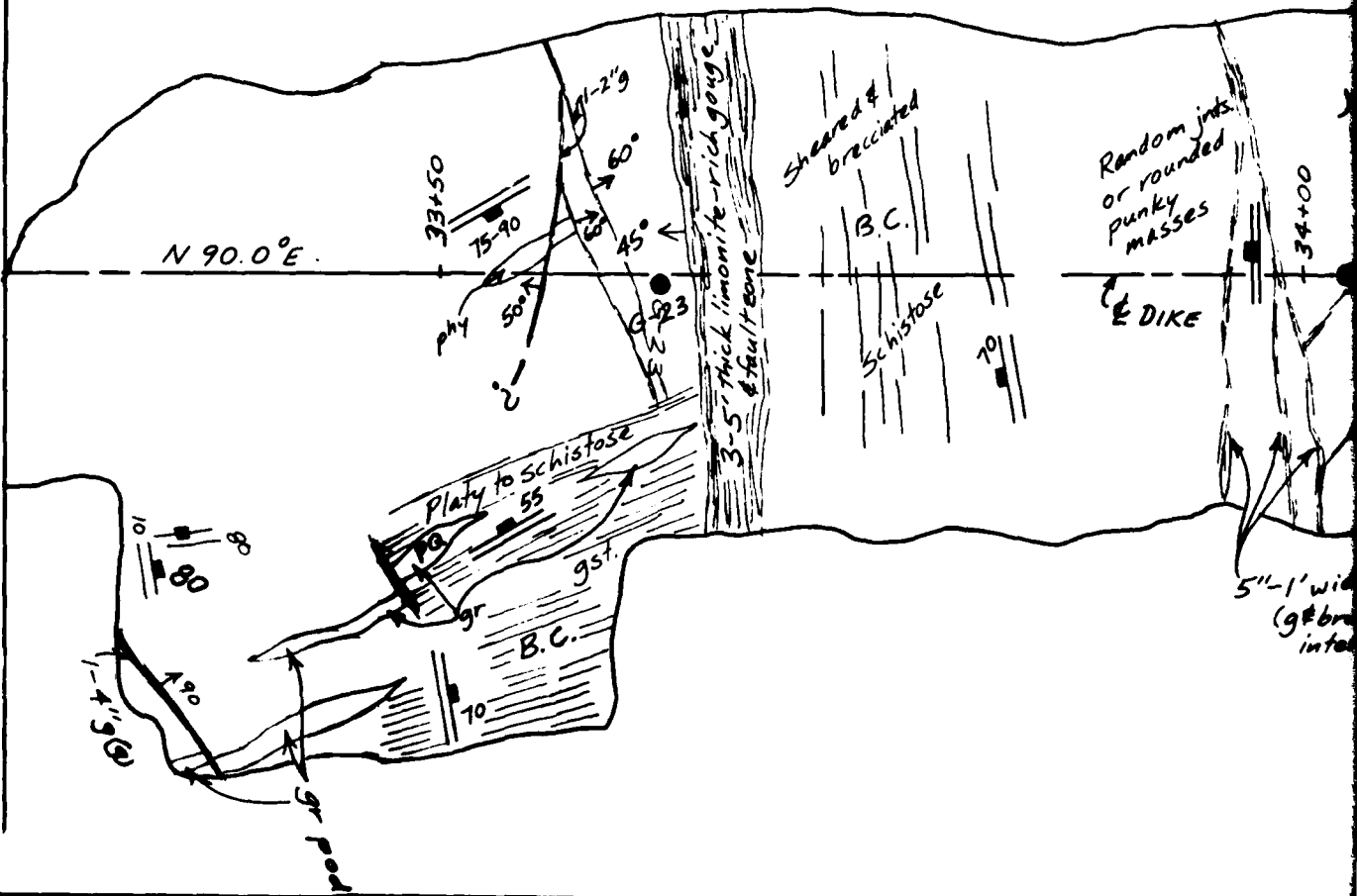
**CAVE BUTTES DAM
FOUNDATION GEOLOGY
LEFT ABUTMENT**

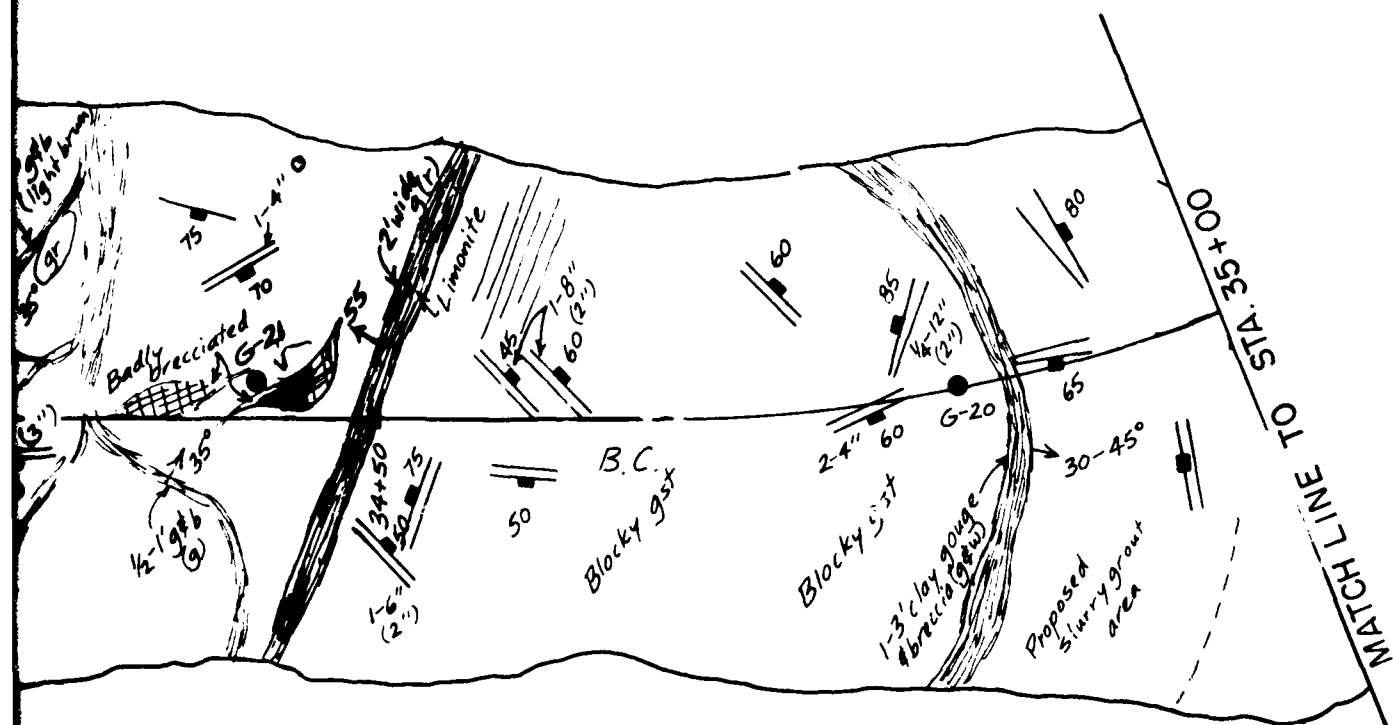
STA. 30+99 to STA. 32+50

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

U.S. ARMY ENGINEER DISTRICT

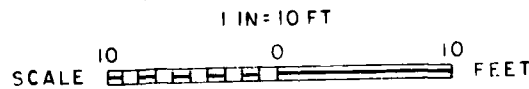
STA. 33+25 - BEGIN DIKE NO.1





NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols.



GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA
CAVE BUTTES DAM
FOUNDATION GEOLOGY
DIKE No. 1
STA. 33+25 to STA. 35+00
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

AD-A137 732

CAVE BUTTES DAM FOUNDATION REPORT GILA RIVER BASIN:
PHOENIX ARIZONA AND VICINITY (INCLUDING NEW RIVER)(U)
ARMY ENGINEER DISTRICT LOS ANGELES CA AUG 83

3/3

UNCLASSIFIED

F/G 13/13

NL

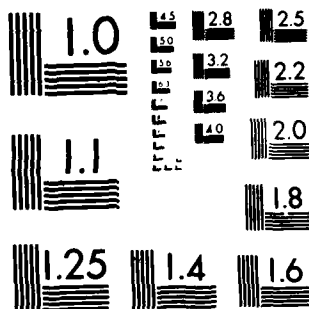
END

DATE

FILMED

3-84

DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

MATCH LINE TO STA. 35+00

1-8" 60

1-3" g(r) 70-80

1-2" g(r) 65

1-3" g(r)

1-6" g(9#y)

1-12" (8") 60

1-10" (4") 70

1-2" g(r) 65

1-3" g(r)

1-4" g(r)

1-5" g(r)

1-6" g(r)

1-7" g(r)

1-8" g(r)

1-9" g(r)

1-10" g(r)

1-11" g(r)

1-12" g(r)

60

70

80

90

65

75

60

45

30

20

15

10

5

0

Black oxidation on khaki-colored blocky gst

B.C.

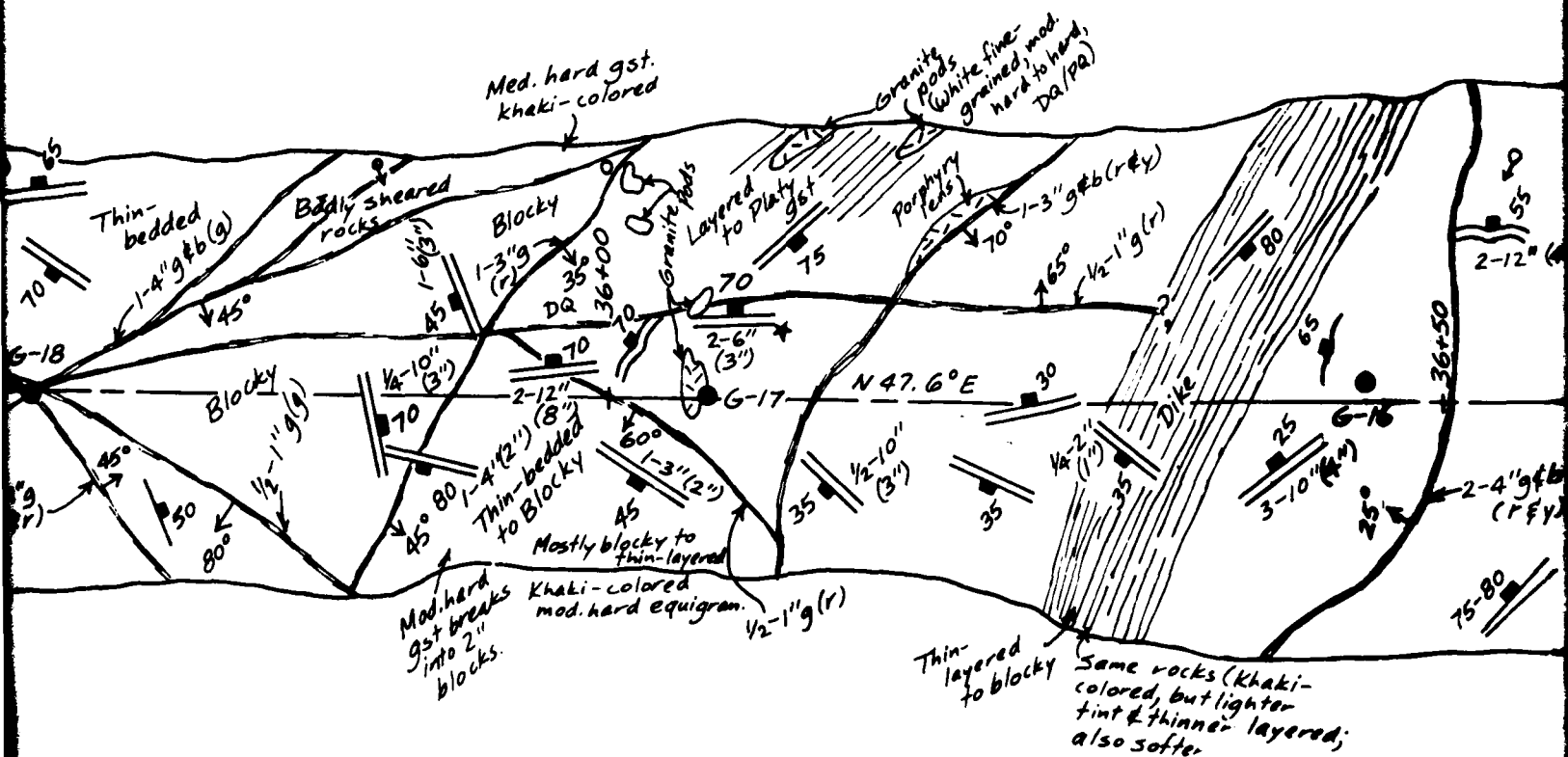
Porphyry band

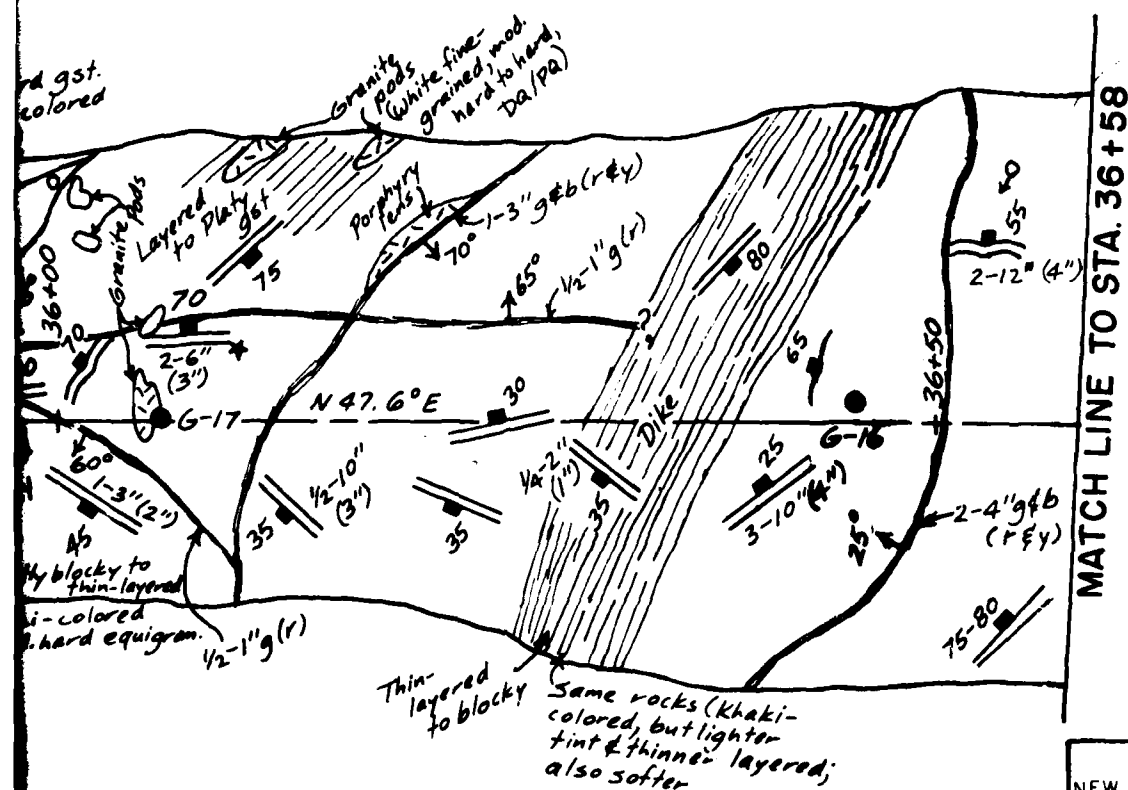
Blocky gst

Thin-bedded

Proposed slurry grout area

0 100





NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols.

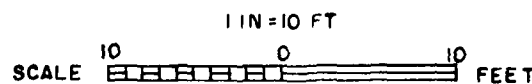
GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

**CAVE BUTTES DAM
FOUNDATION GEOLOGY**

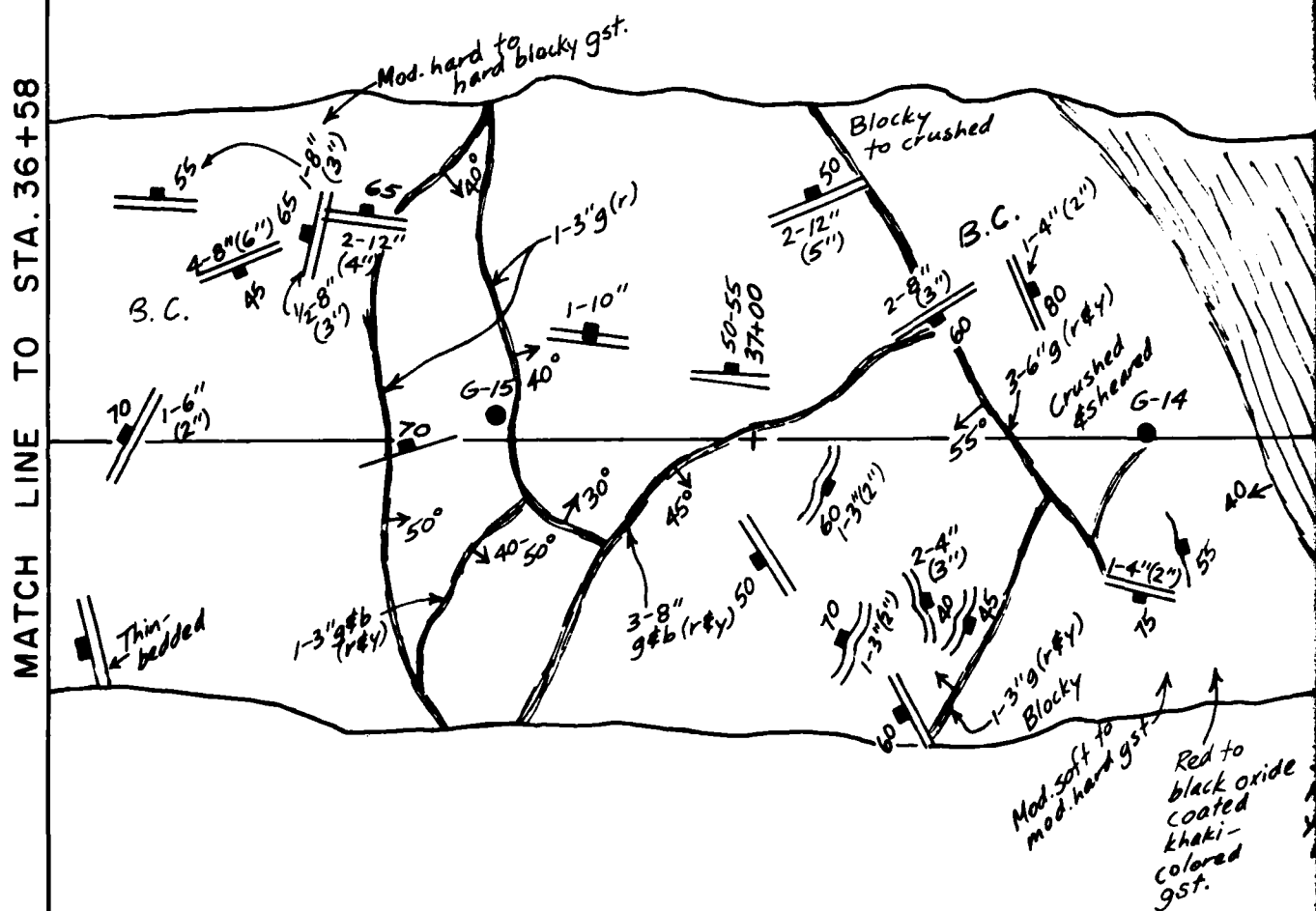
DIKE No. 1

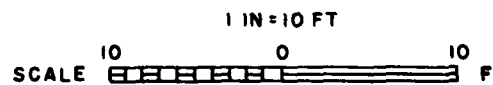
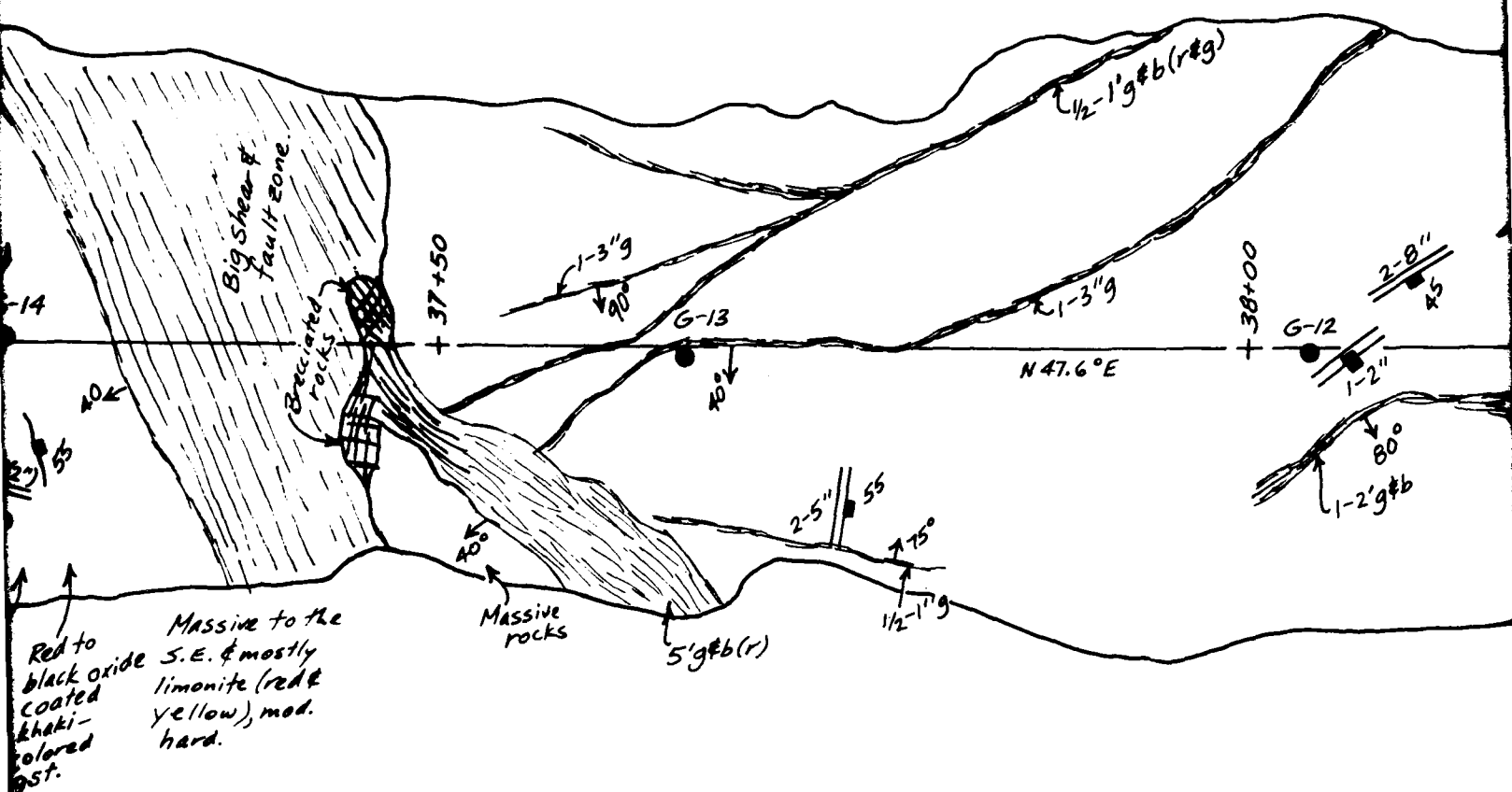
STA. 35+00 to STA. 36+58

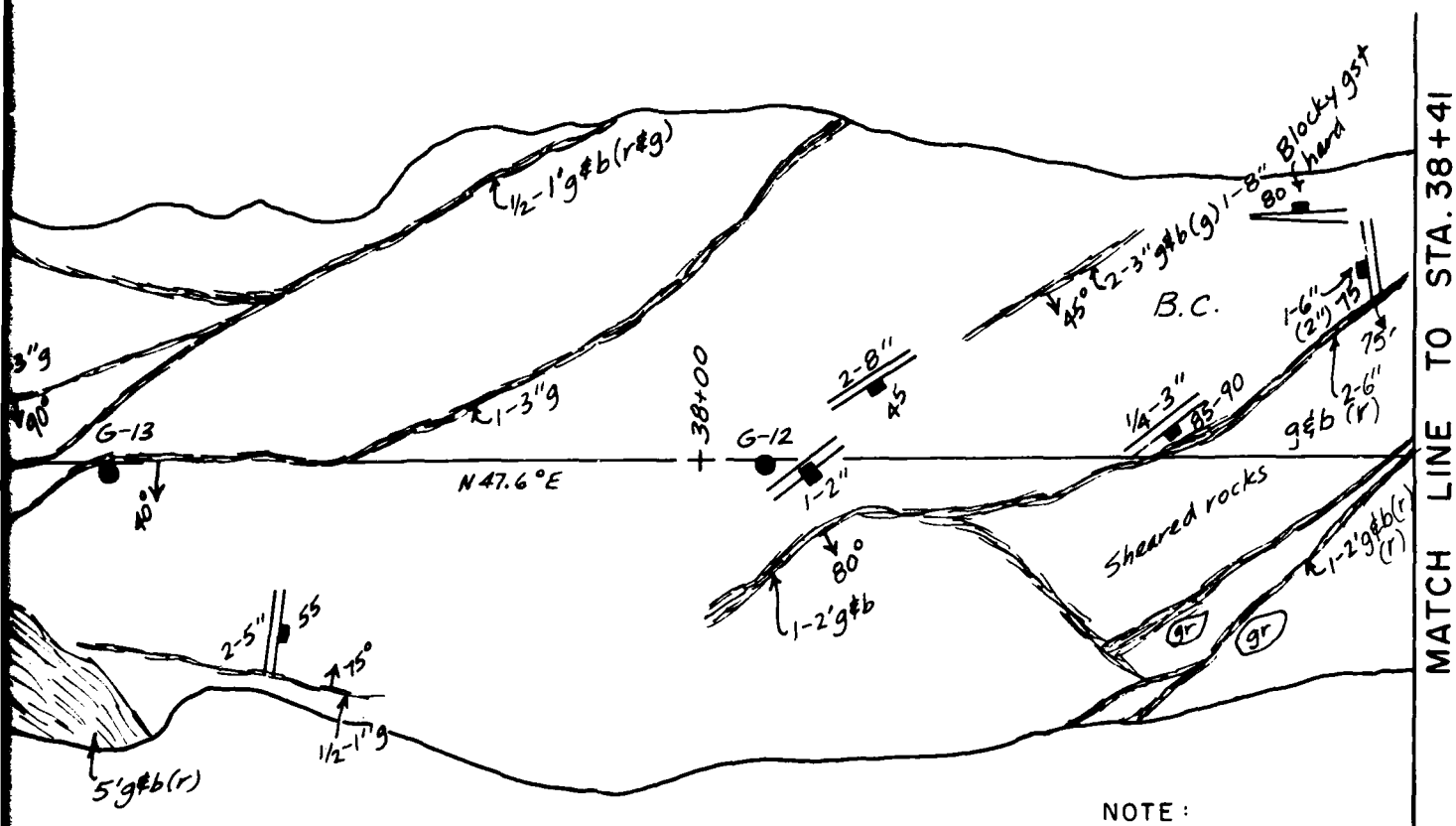
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:



U.S. ARMY ENGINEER DISTRICT







NOTE :

Refer to Plate 24 for Rock descriptions and explanations of symbols.

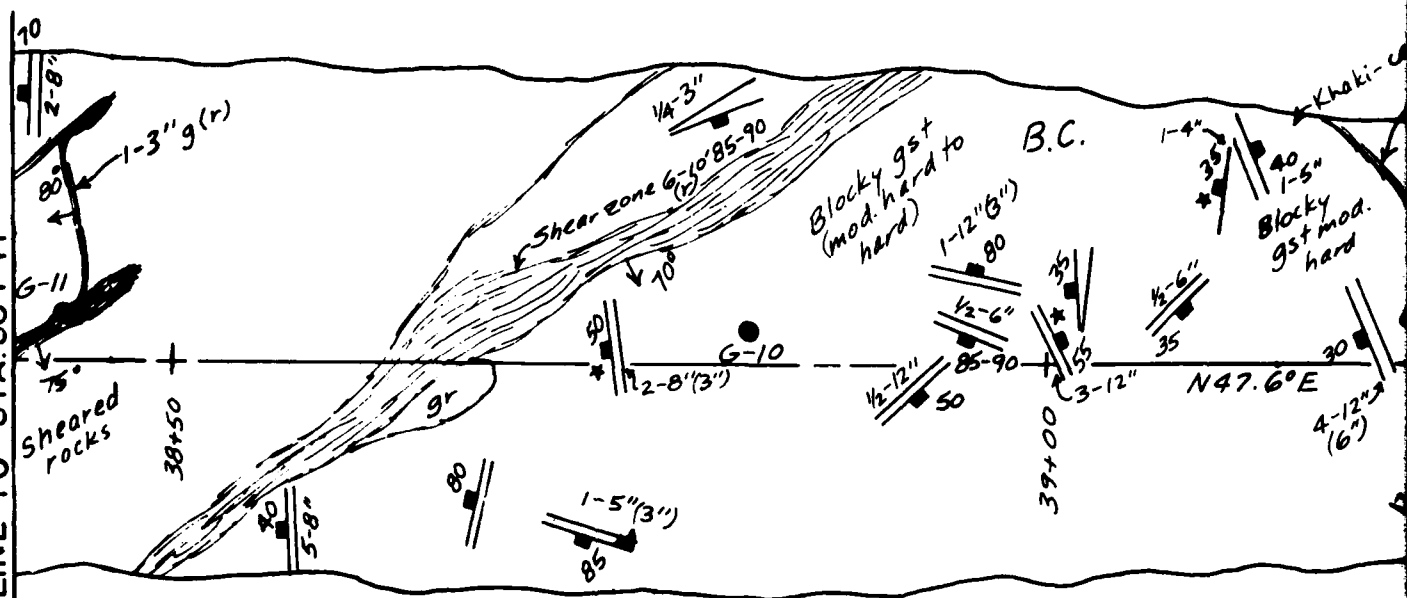
**GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA
CAVE BUTTES DAM
FOUNDATION GEOLOGY
DIKE No. 1
STA. 36+58 to STA. 38+41**

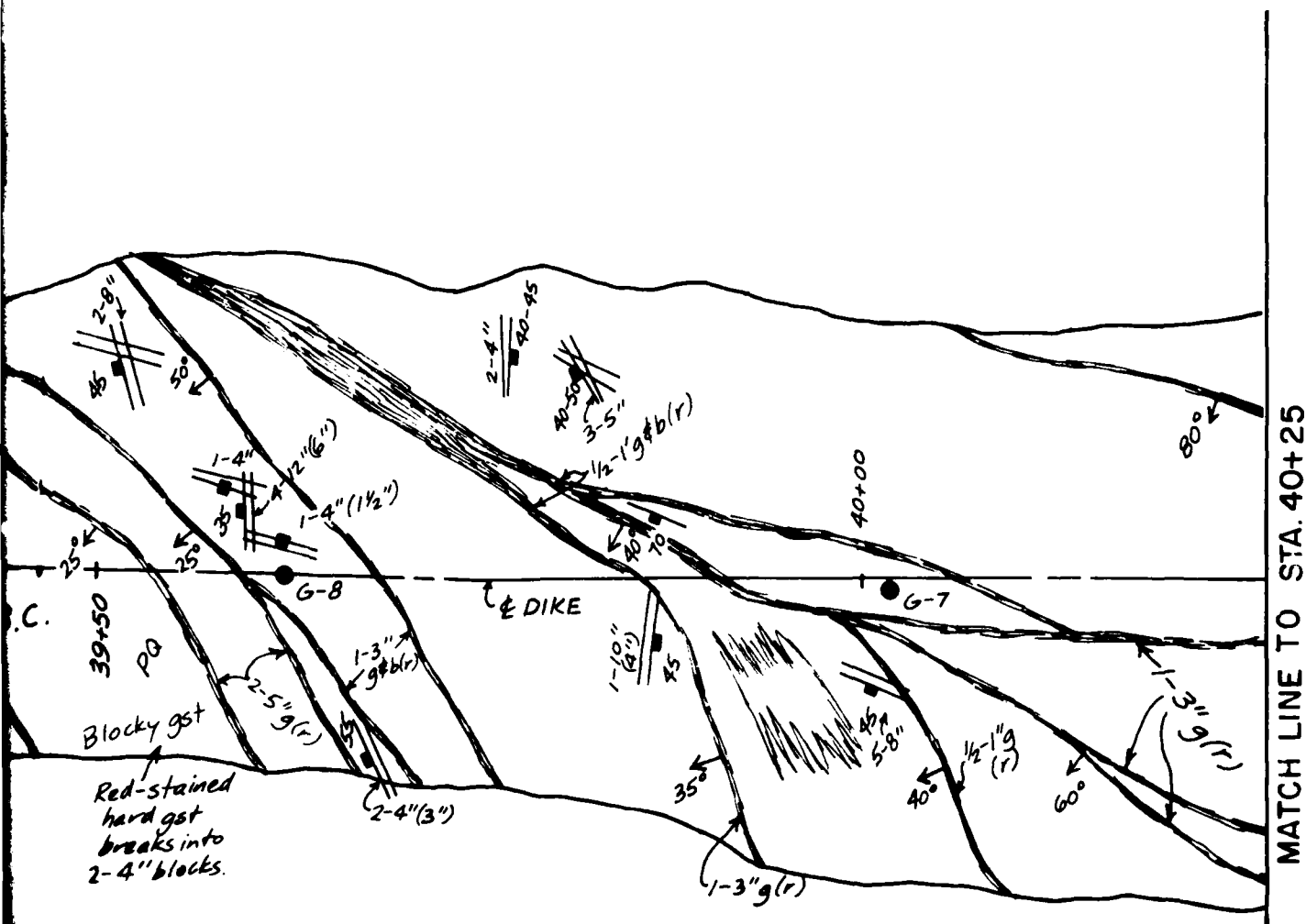
**U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:**

1 IN = 10 FT

SCALE 10 0 10 FEET

MATCH LINE TO STA. 38+41





NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols.

1 IN = 10 FT

SCALE 10 0 10 FEET

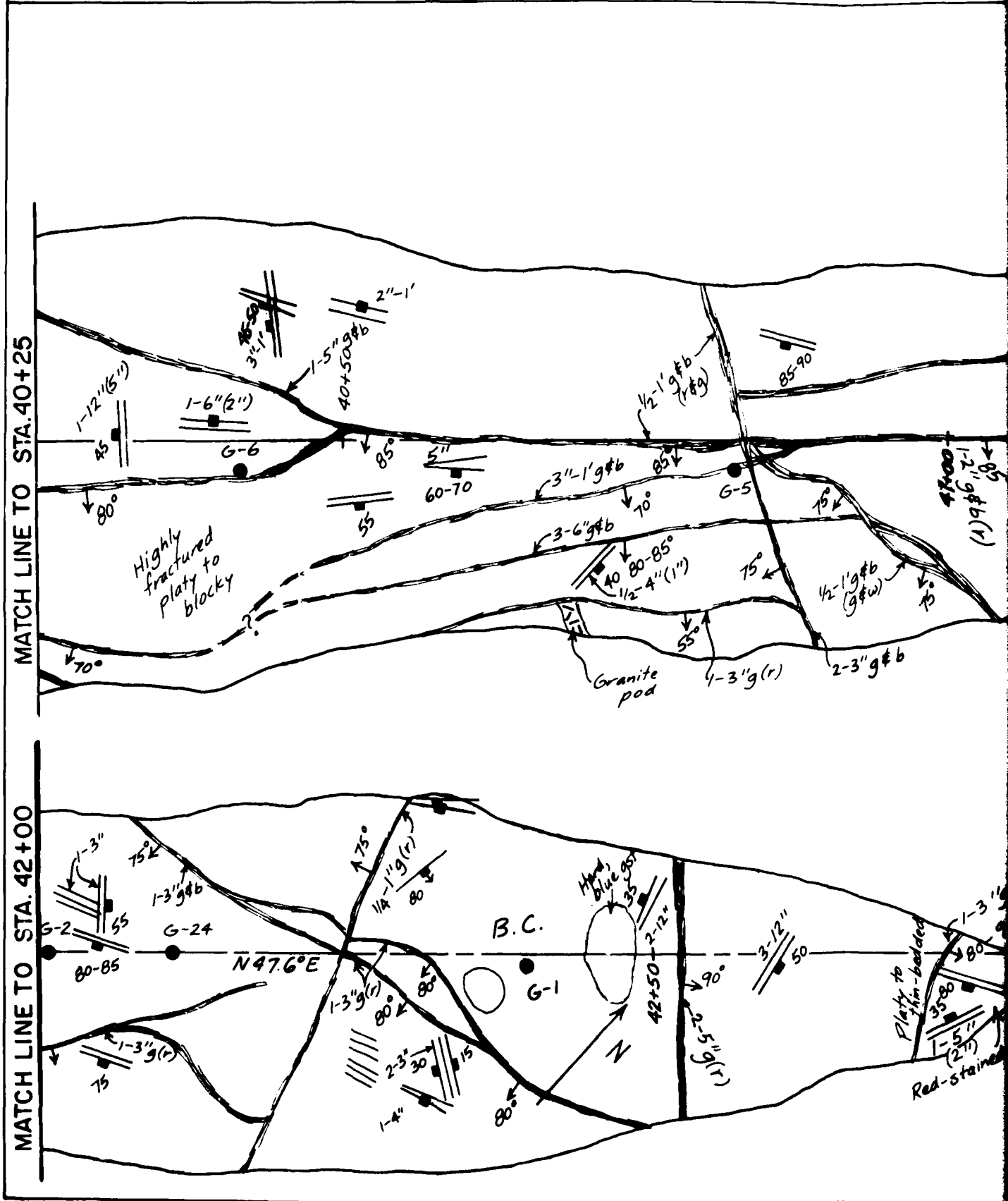
GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

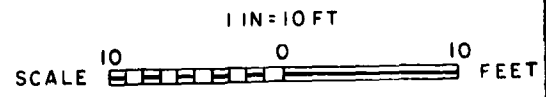
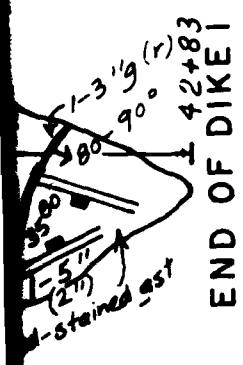
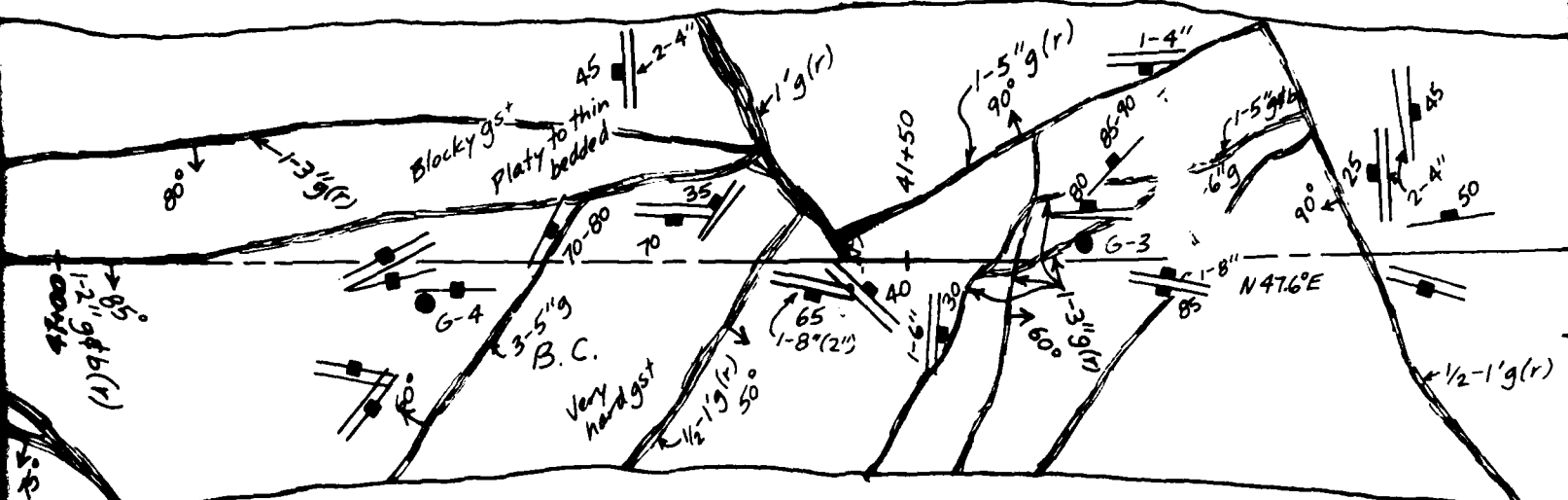
**CAVE BUTTES DAM
FOUNDATION GEOLOGY**

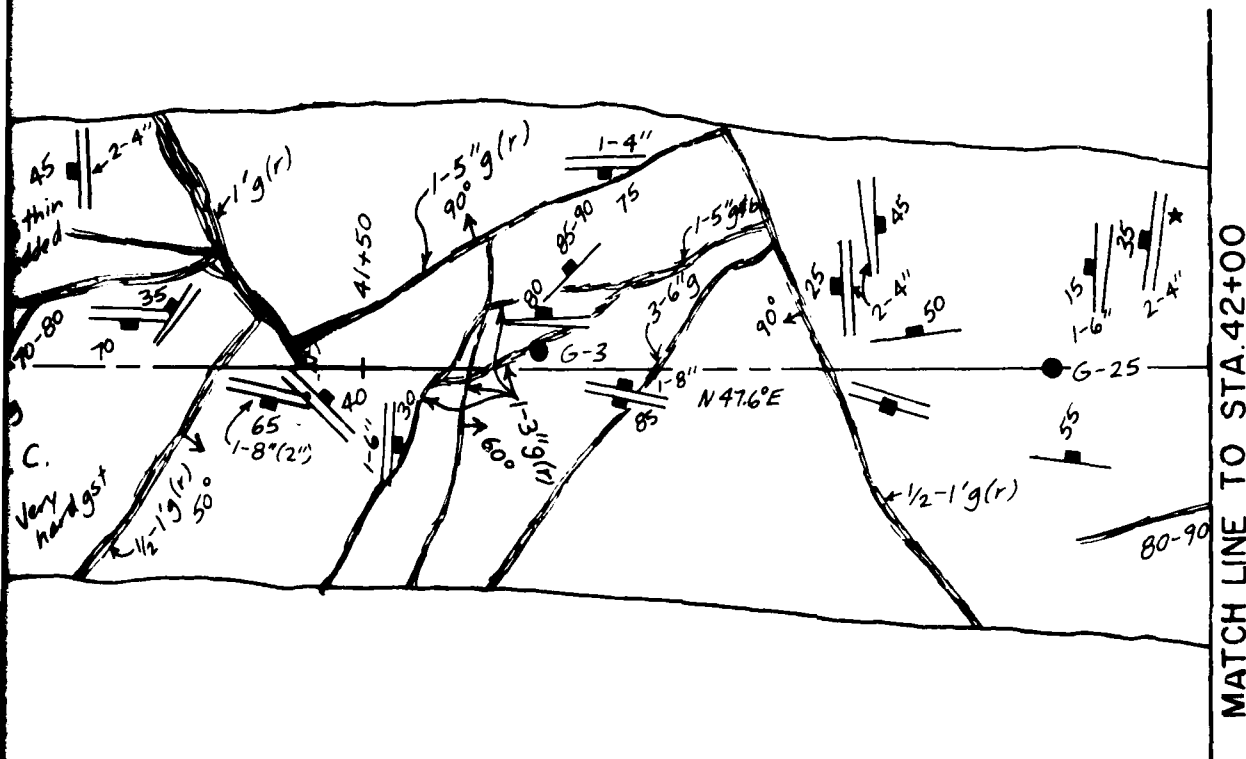
**DIKE No. 1
STA. 38+41 to STA. 40+25**

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

U.S. ARMY ENGINEER DISTRICT

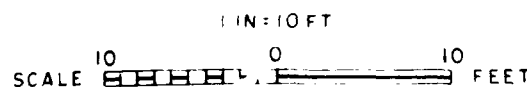






NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols.



GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

**CAVE BUTTES DAM
FOUNDATION GEOLOGY**

DIKE No. 1

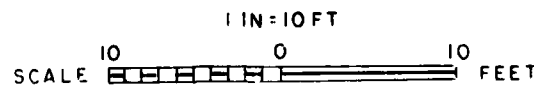
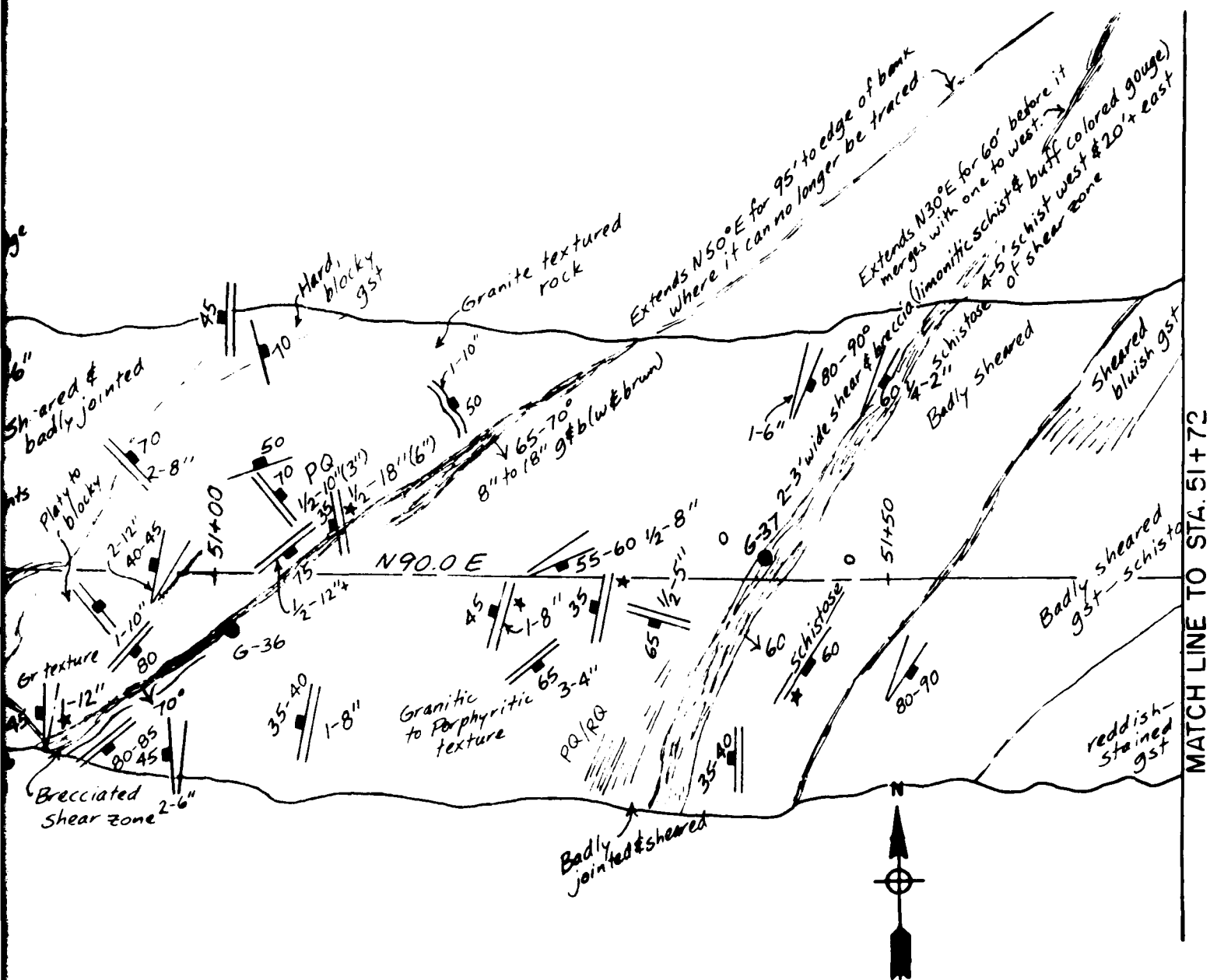
STA. 40+25 to STA. 42+83

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

U.S. ARMY ENGINEER DISTRICT

STA. 50+09 - BEGIN DIKE NO. 2

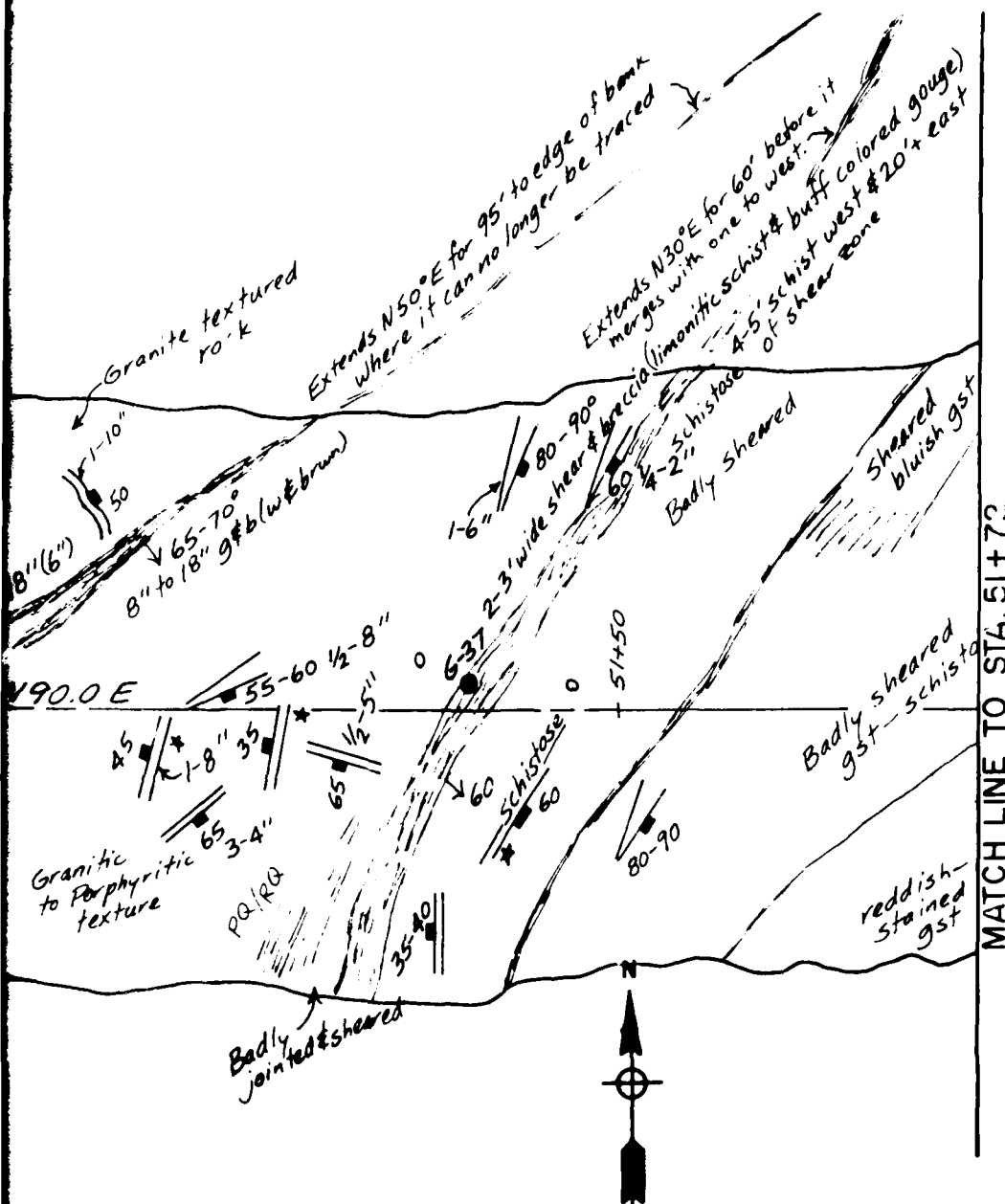




NEW

U.
LOS
TO A

FOUNDAT



NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols.

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

**CAVE BUTTES DAM
FOUNDATION GEOLOGY**

DIKE No. 2

STA. 50+09 to STA. 51+72

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

MATCH LINE TO STA. 51+72

Geological Features and Units:

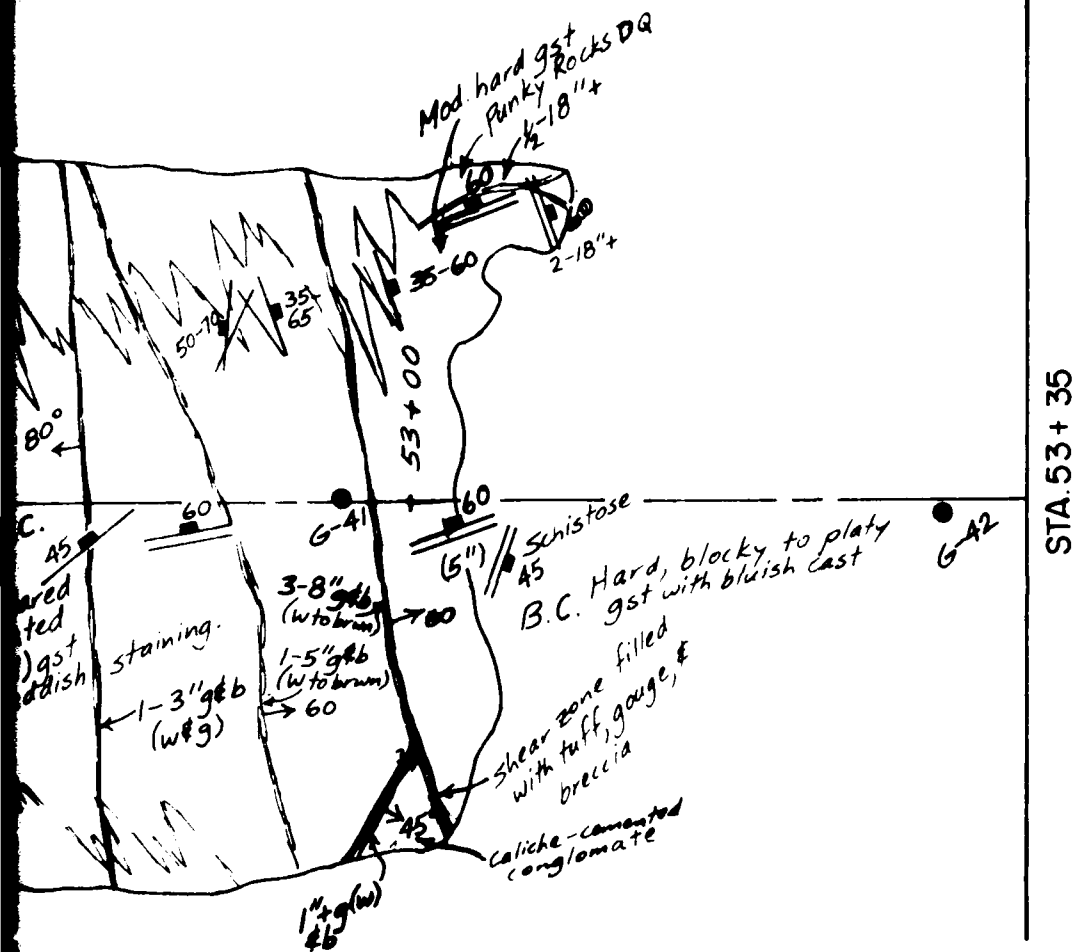
- Mod. hard bluish gst fragments** (top left)
- Angular bluish gst frags.** (top center)
- Hard bluish gst mostly massive but also angular blocks** (top right)
- B.C. Sheared bluish gst** (middle left)
- Matrix buff to white** (middle right)
- Coating of Tuffaceous Agglomerate with bluish gst** (bottom center)
- Badly sheared & altered gst stained reddish color.** (bottom right)
- Area of f.g. granitic texture (grayish gst)** (bottom left)

Structural Features and Measurements:

- 6-38**, **45**, **65-70**, **35**, **1-8" jnts**, **40**, **70 B.C.**, **1-6" 2-6"**, **2-7" 60**, **Sheared & weath. 45**, **gst (reddish stained)**
- 6-8"**, **60**, **3-8" 55-60**, **gst**, **4-8" jnts**, **55**, **52+00**
- 52+50**, **3-6" g#b(r)**

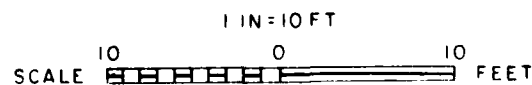
Rock Units and Symbols:

- QT+** (Quartzite)
- B.C.** (Basaltic Conglomerate)
- DQ** (Dark Quartzite)
- AS** (Amphibolite)
- g#b(r)** (Gneiss, blue to reddish)



NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols.



GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

**CAVE BUTTES DAM
FOUNDATION GEOLOGY**

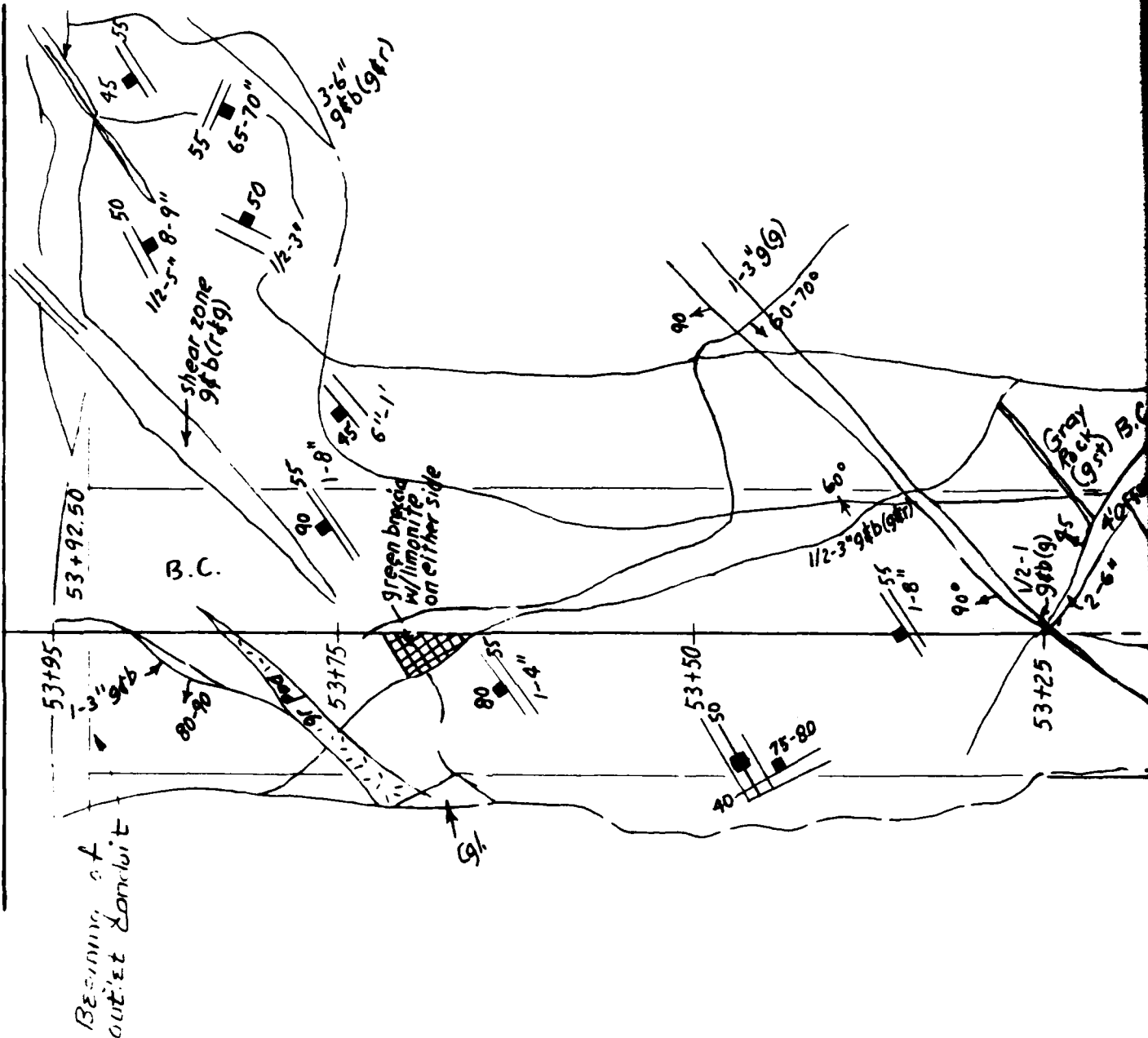
DIKE No. 2

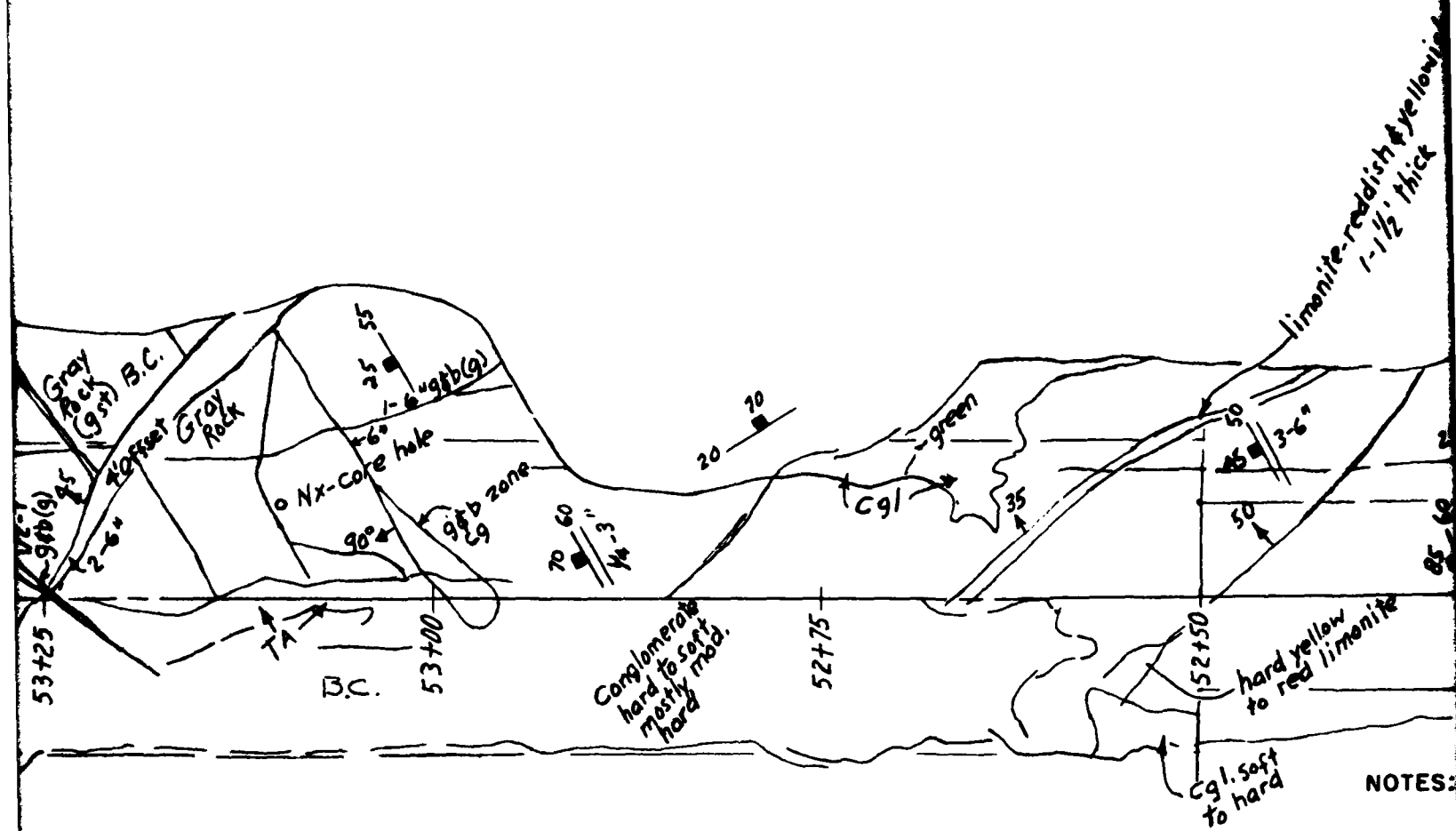
STA. 51+72 to STA. 53+35

**U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:**

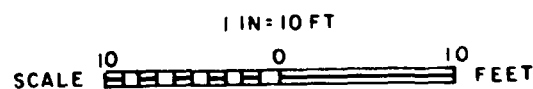
U.S. ARMY ENGINEER DISTRICT

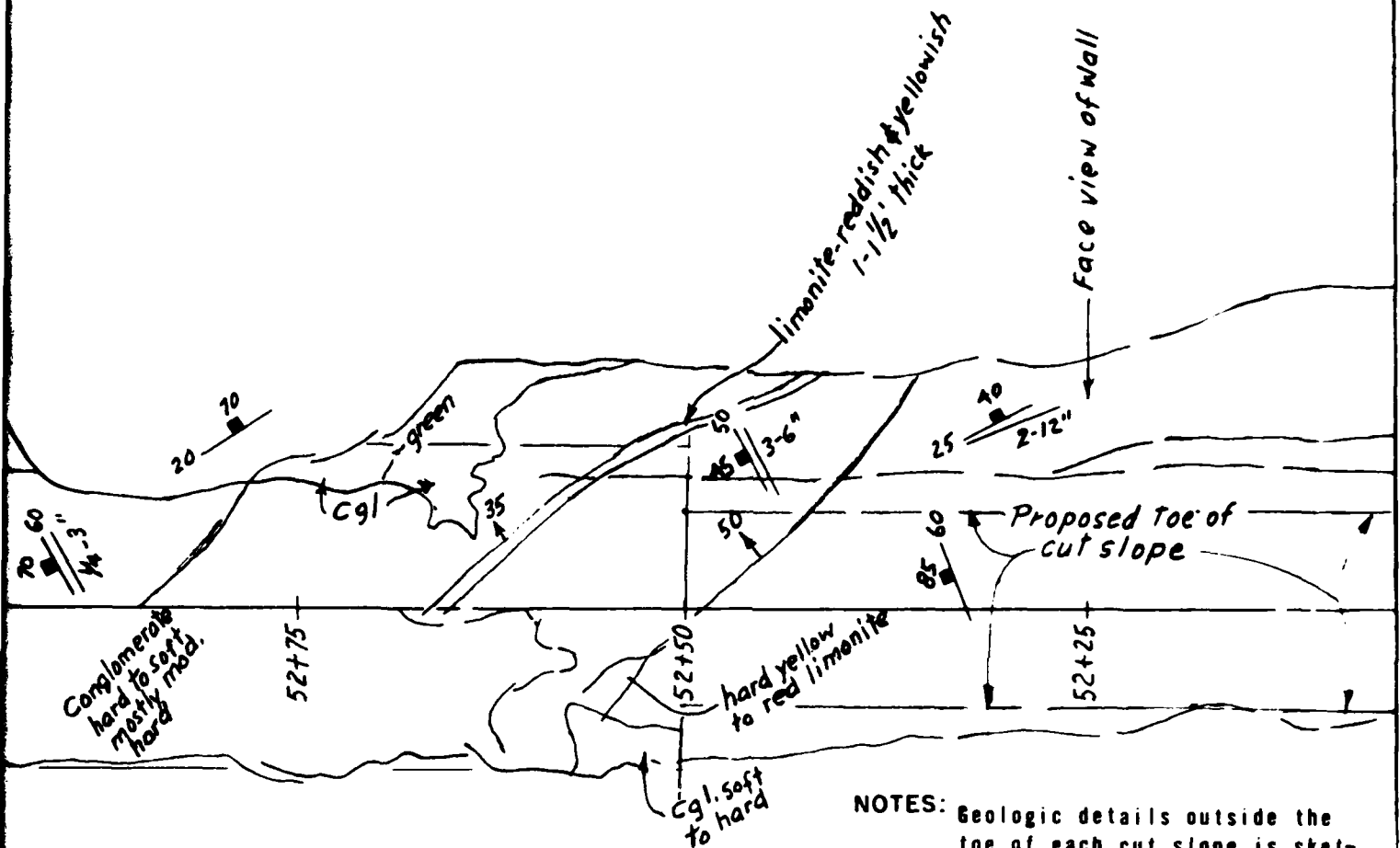
STA 53+98





NOTES:



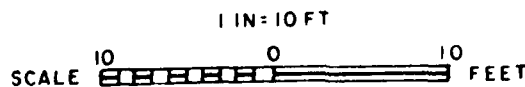


NOTES: Geologic details outside the toe of each cut slope is sketched as a face view of the cut slope. Other data, including grout hole locations and geology at foundation grade between the cut slopes are shown in Plan.

Refer to Plate 24 for Rock descriptions and explanations of symbols

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA
CAVE BUTTES DAM
FOUNDATION GEOLOGY
OUTLET WORKS
STA. 53+98 to STA. 52+05

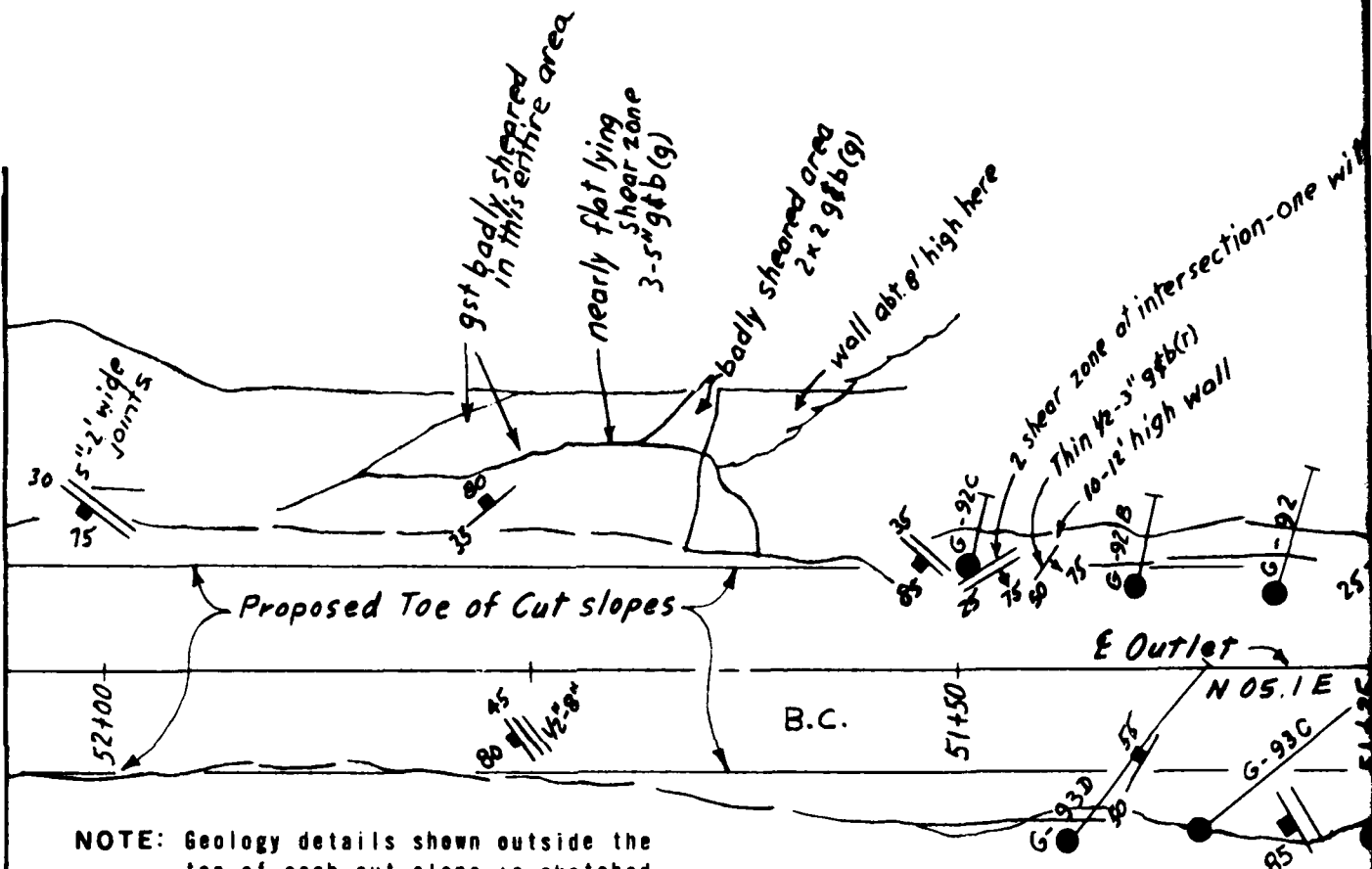
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:



MATCH LINE FOR STA. 52+05

U.S. ARMY ENGINEER DISTRICT

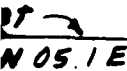
MATCH LINE FOR STA. 52+05



NOTE: Geology details shown outside the toe of each cut slope is sketched as a face view of the cut slope. Other data, including grout hole locations and geology at foundation grade between cut slopes are shown in Plan.

Sta
Sta

1011

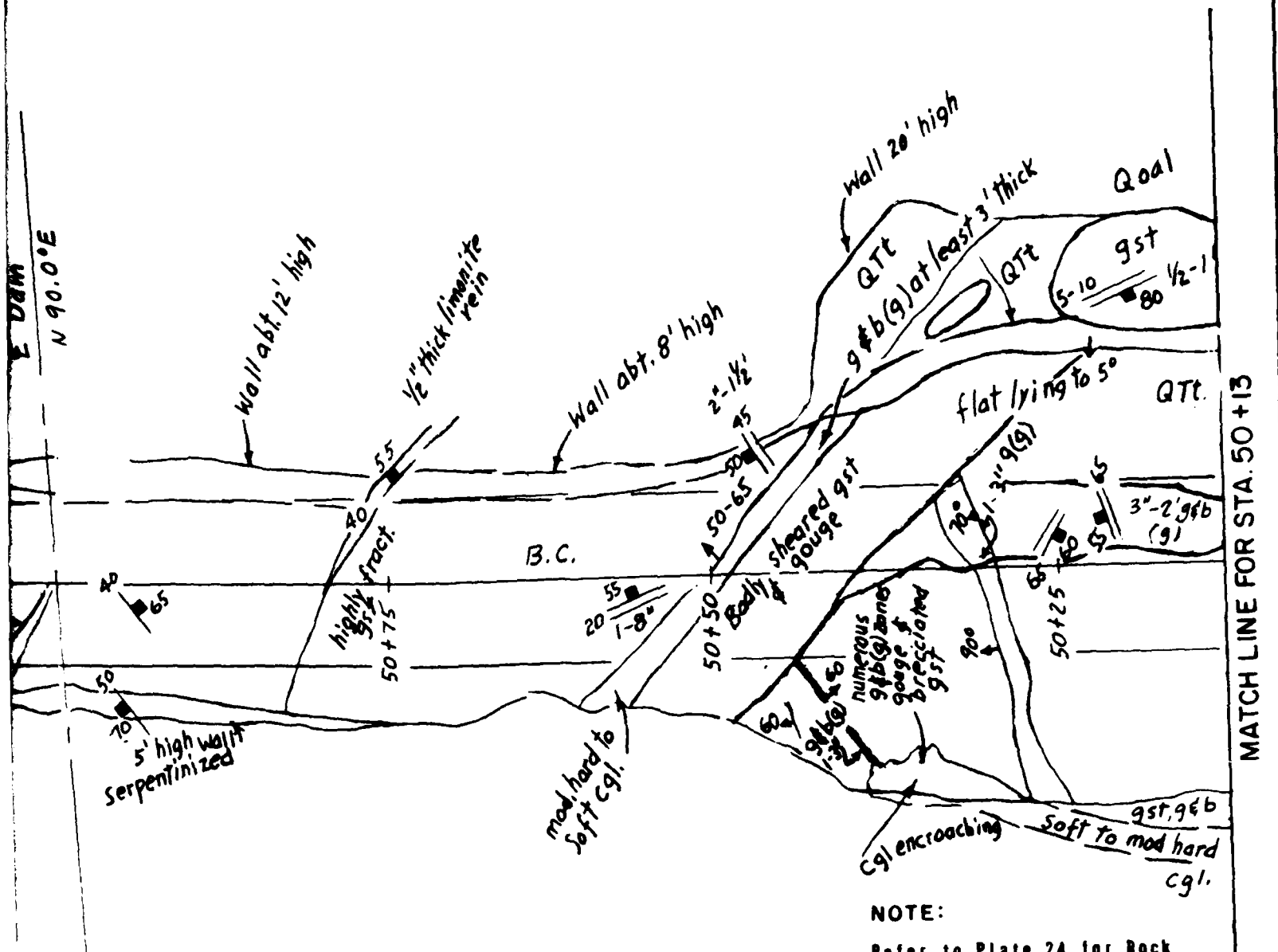


Sta. 50+99.89 E Outlet
Sta. 29+25.46 E Dam

1 IN = 10 FT



CORPS OF ENGINEERS

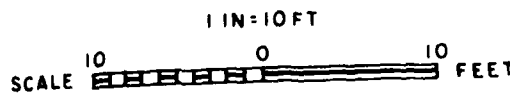


NOTE:

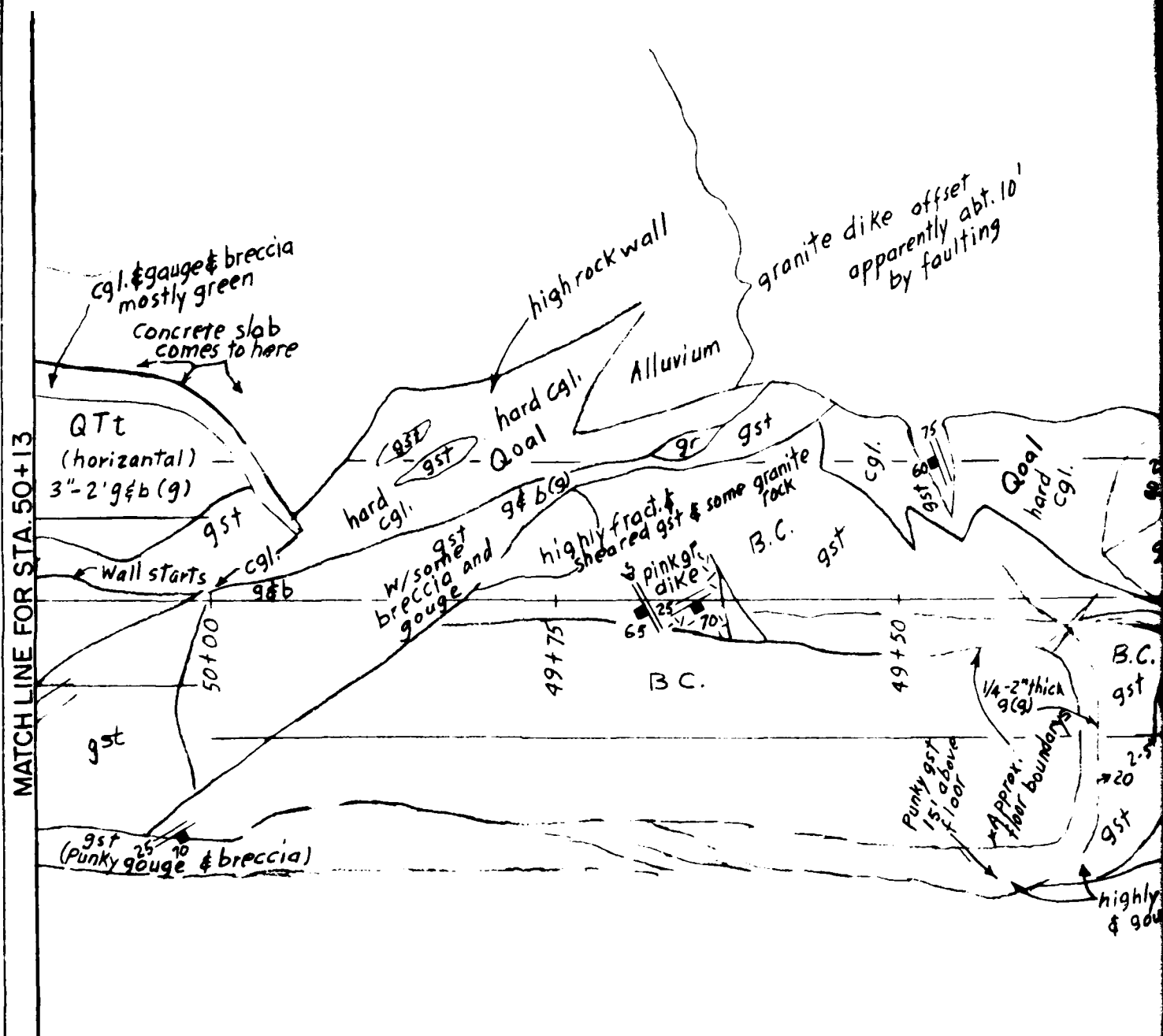
Refer to Plate 24 for Rock descriptions and explanations of symbols

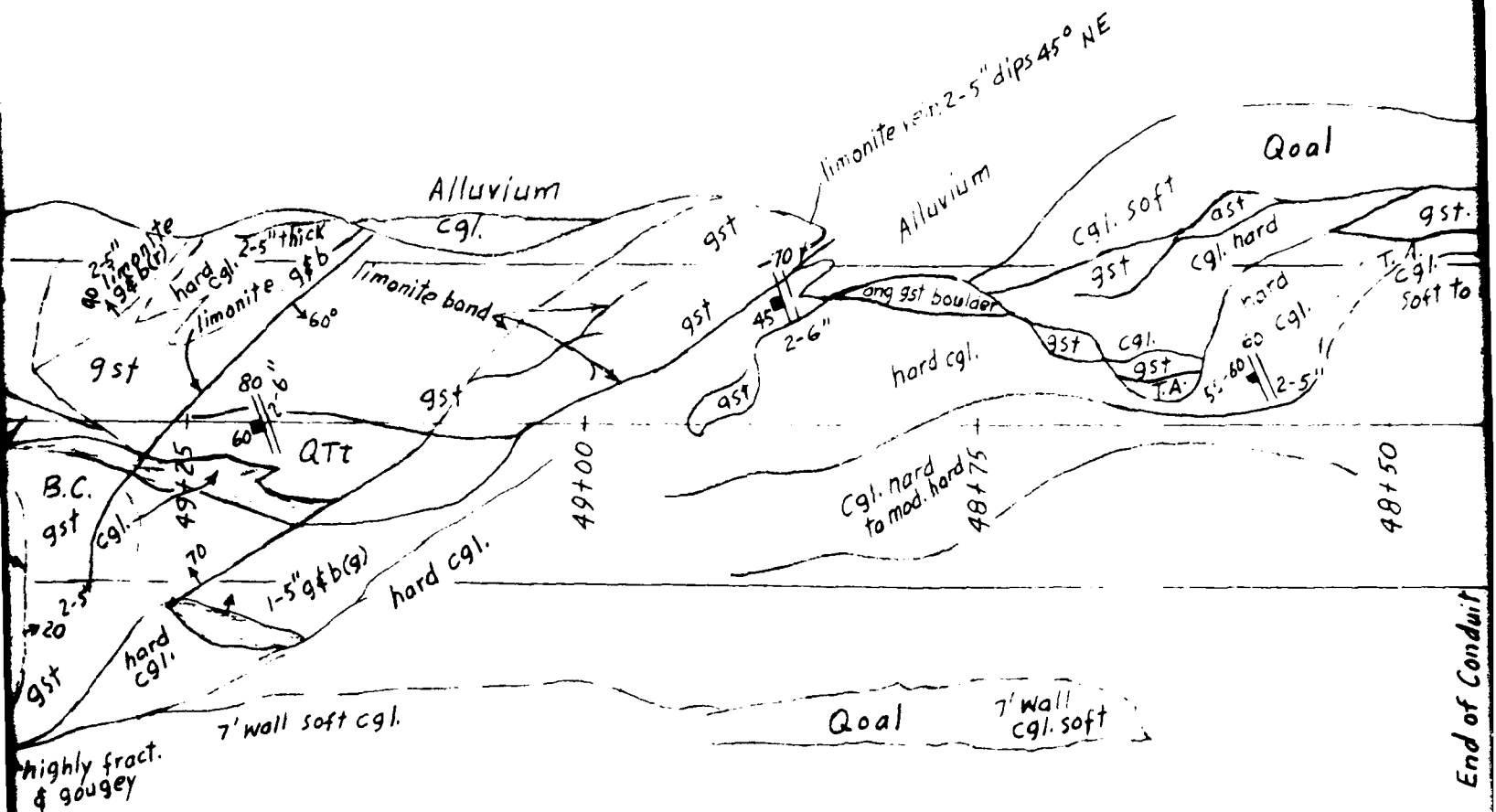
GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA
CAVE BUTTES DAM
FOUNDATION GEOLOGY
OUTLET WORKS
STA. 52+05 to STA. 50+13

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:



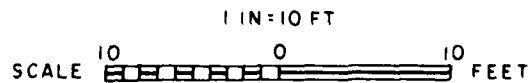
1





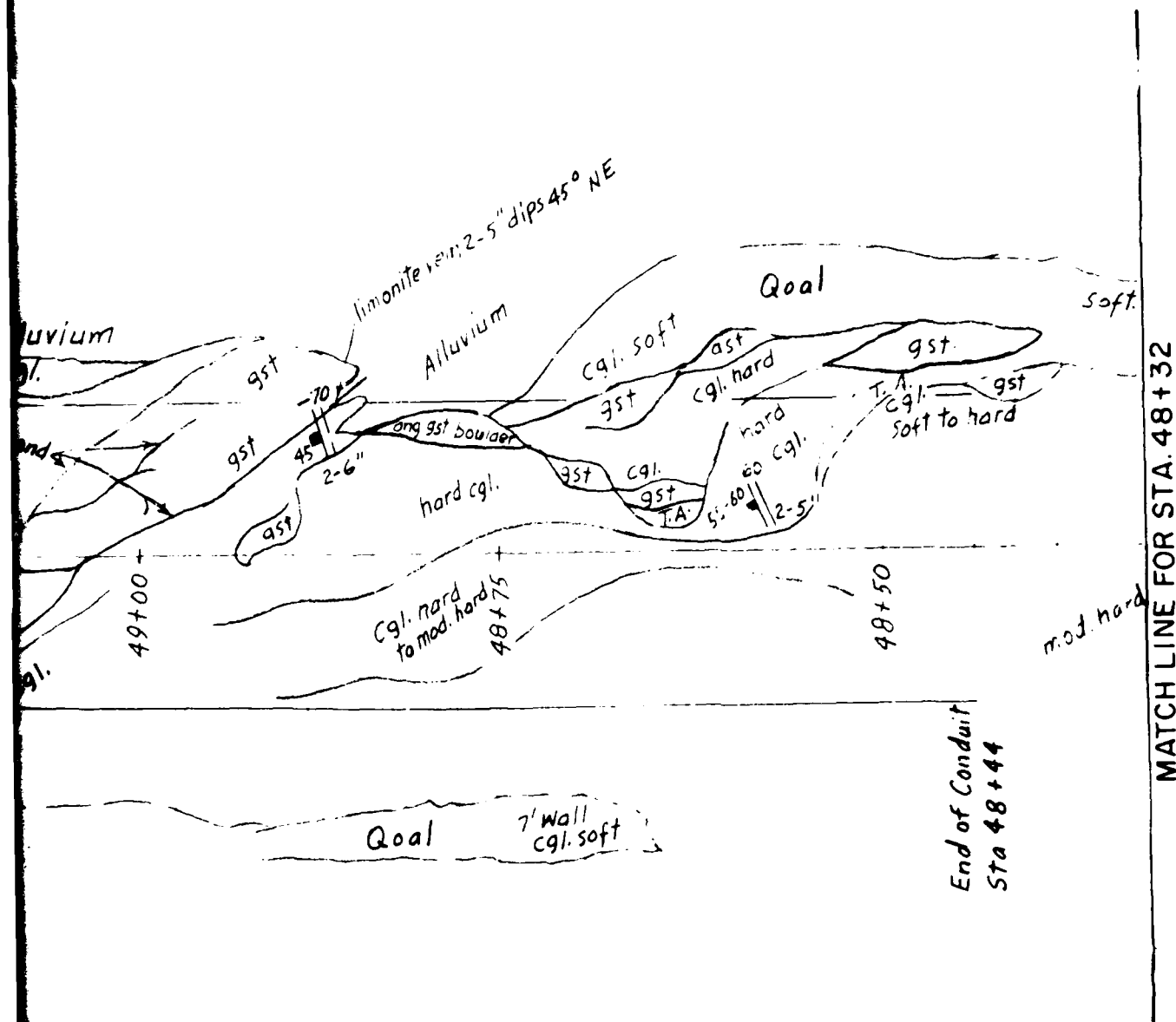
NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols



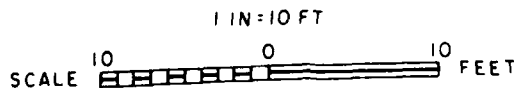
FOUNDATK

2



NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols

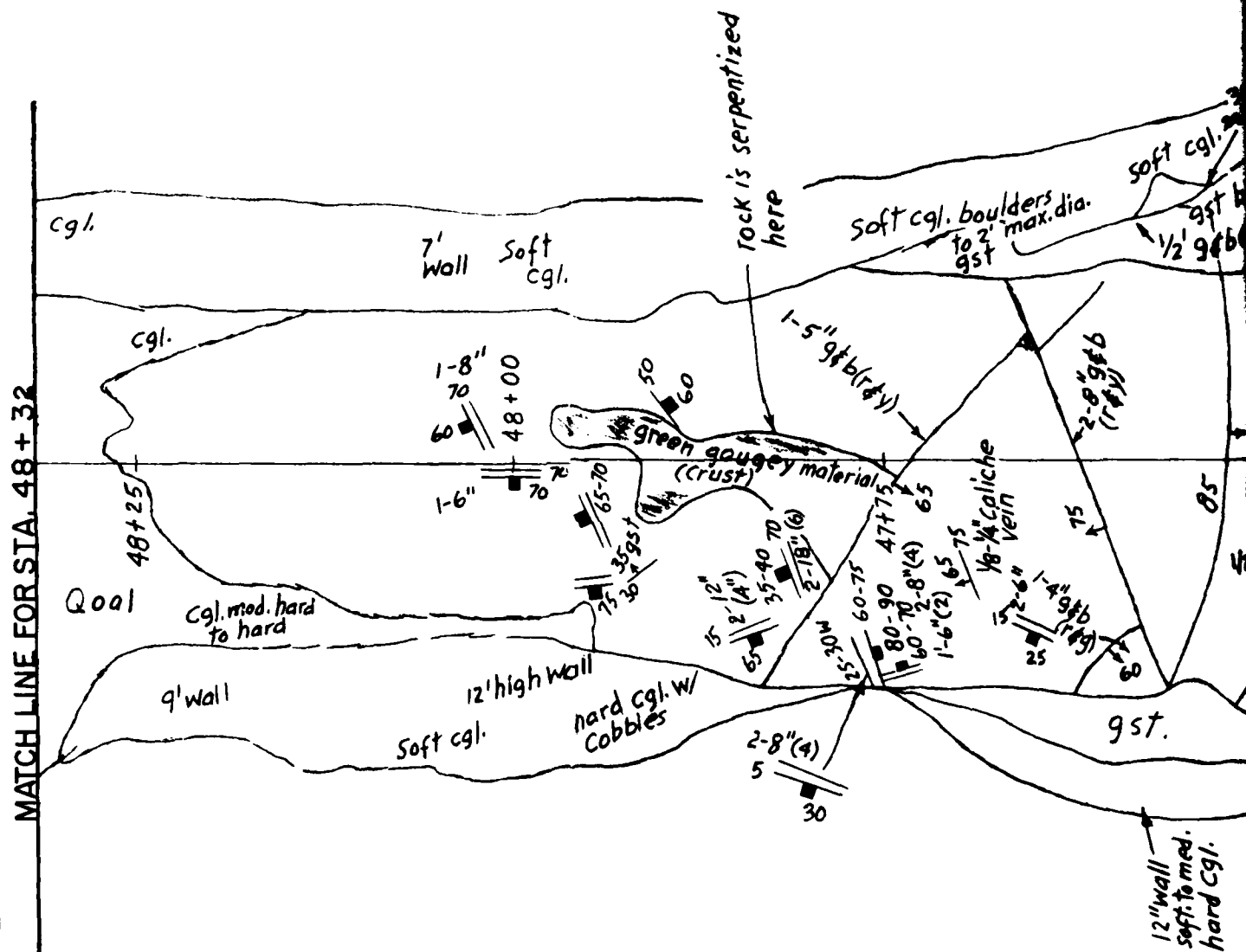


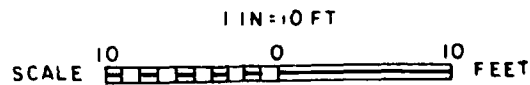
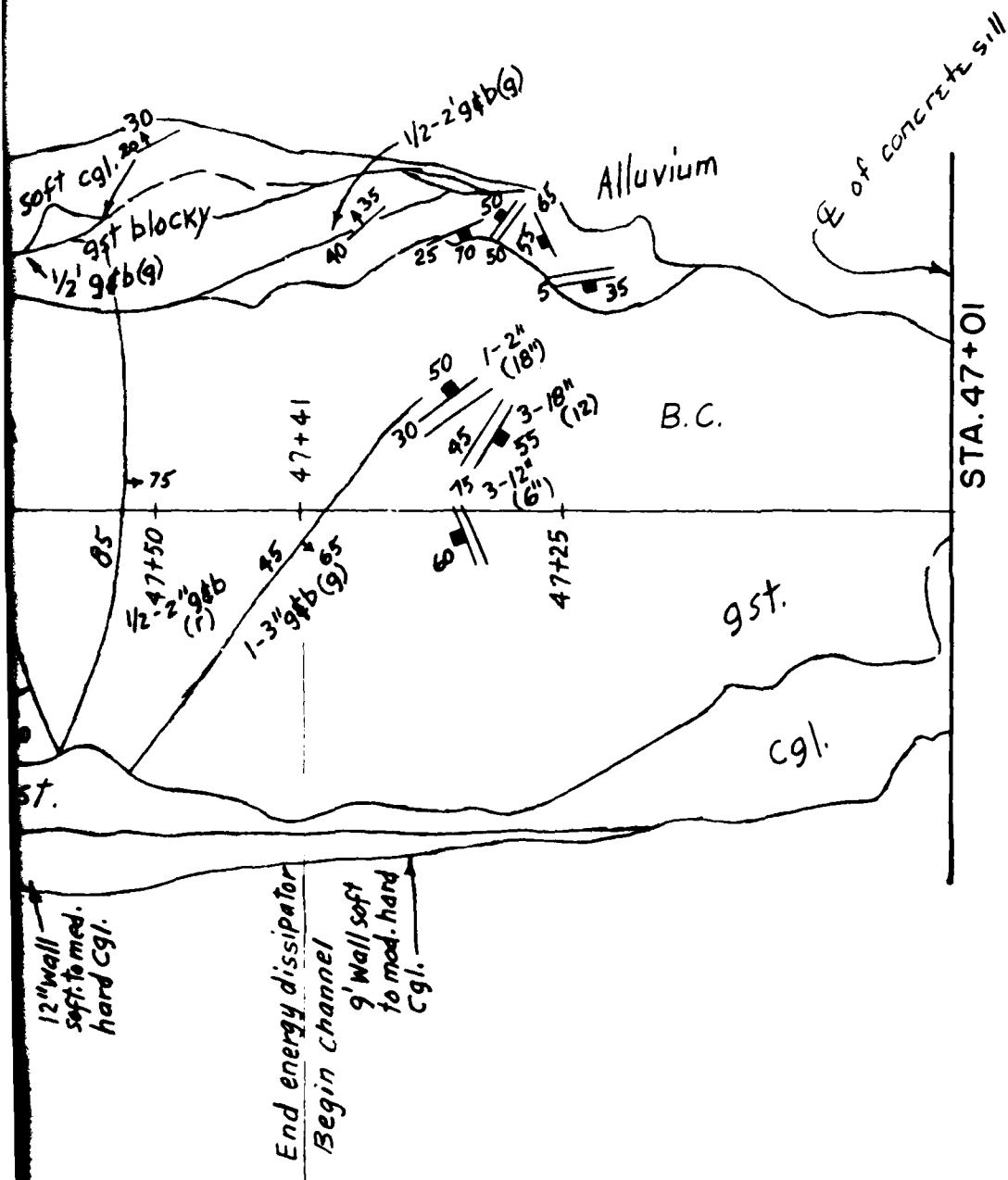
GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

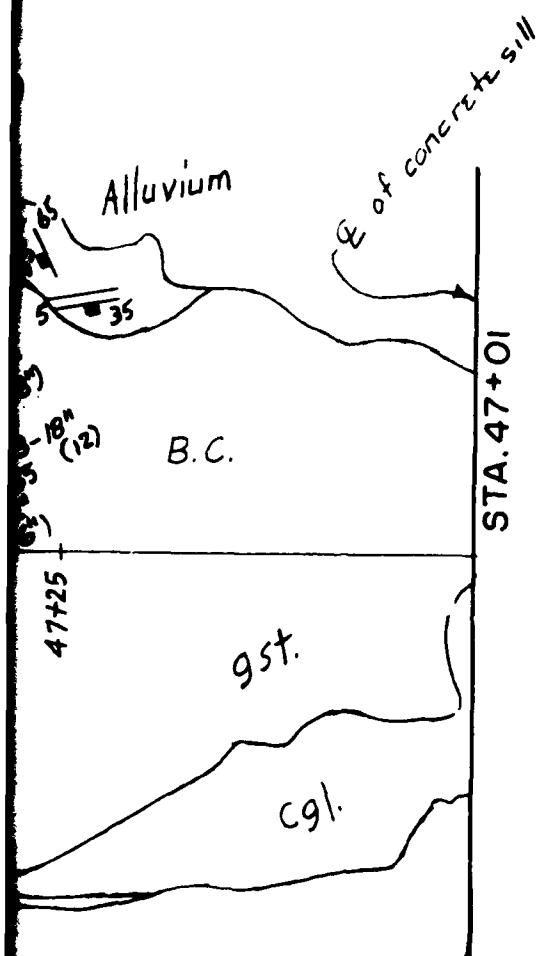
CAVE BUTTES DAM
FOUNDATION GEOLOGY
OUTLET WORKS
STA. 50+13 to STA. 48+32

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

1







NOTE:

Refer to Plate 24 for Rock
descriptions and explanations
of symbols

GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

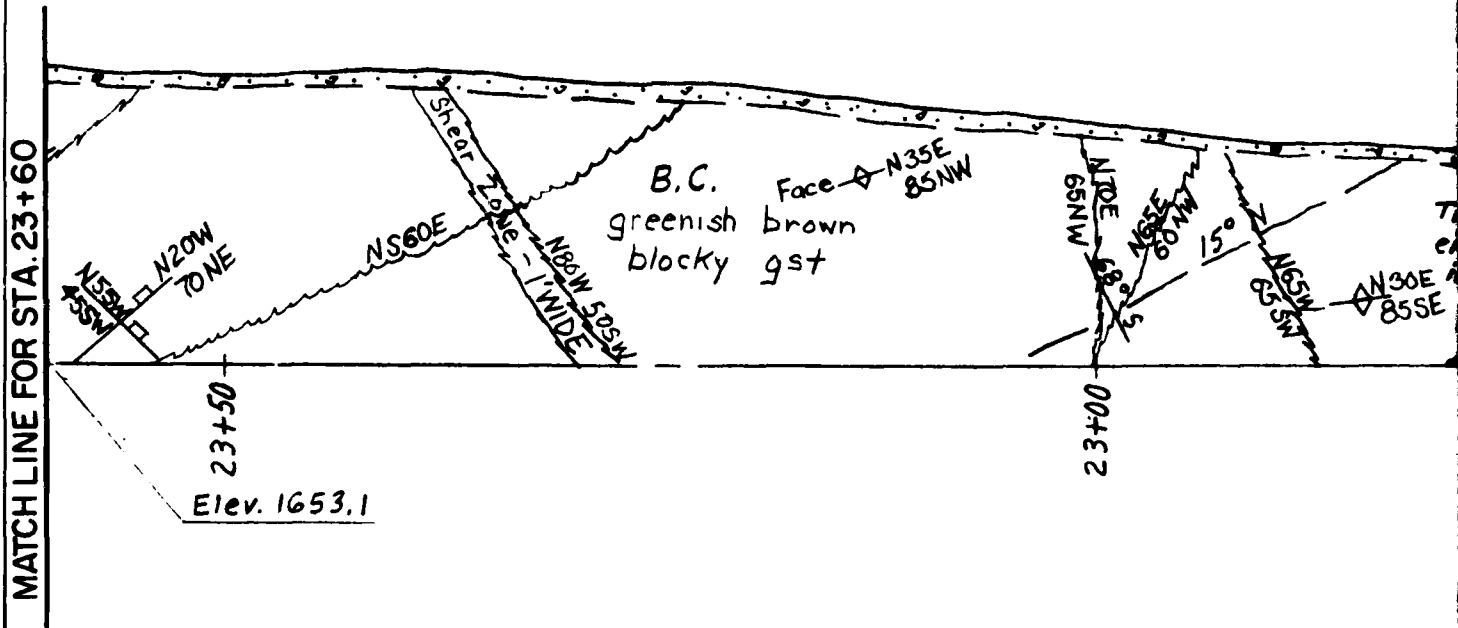
CAVE BUTTES DAM
FOUNDATION GEOLOGY
OUTLET WORKS

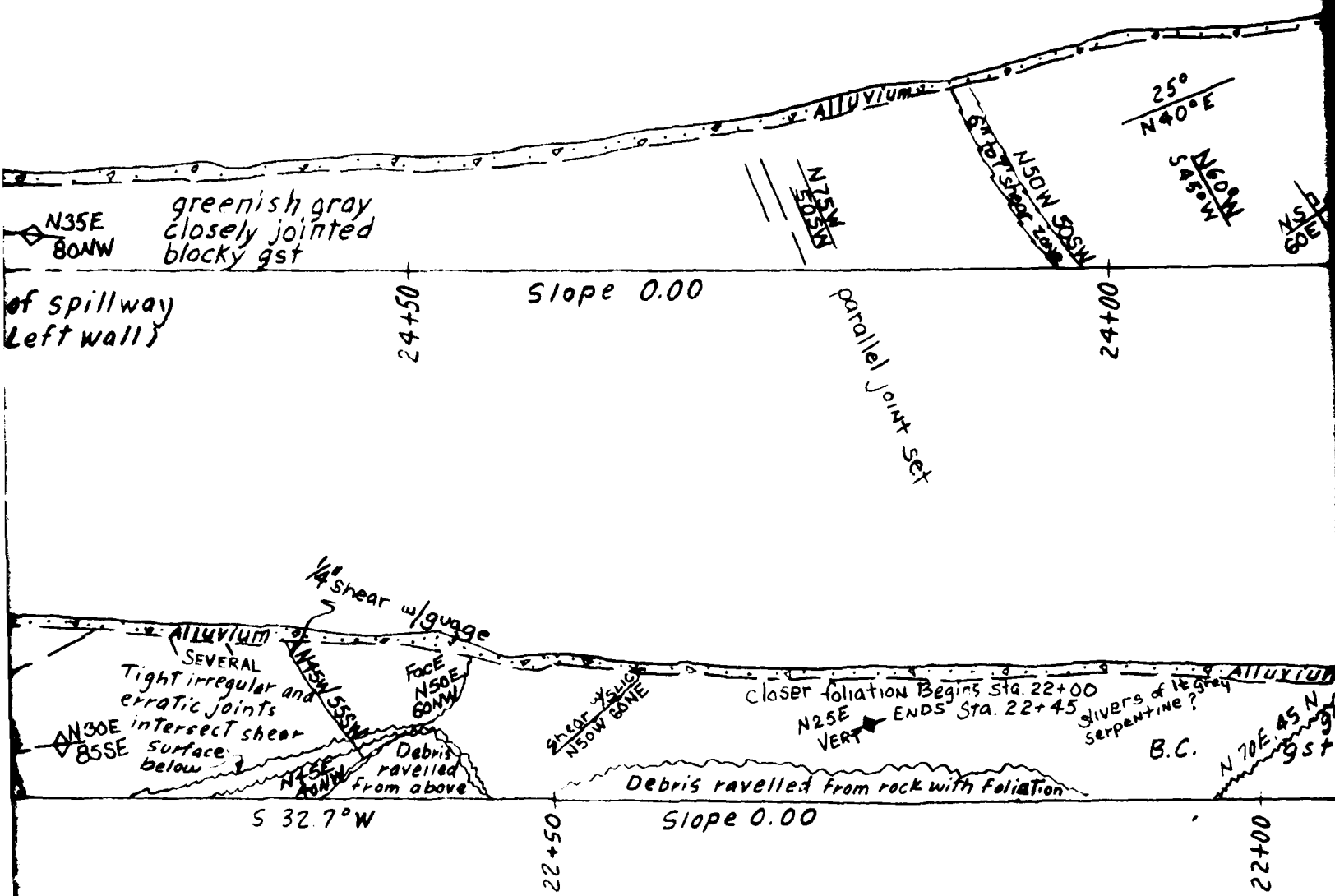
STA. 48+32 to STA. 47+01

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

1 IN = 10 FT
SCALE 10 0 10 FEET

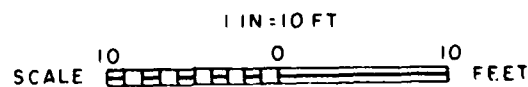
BEGIN SPILLWAY EAST WALL



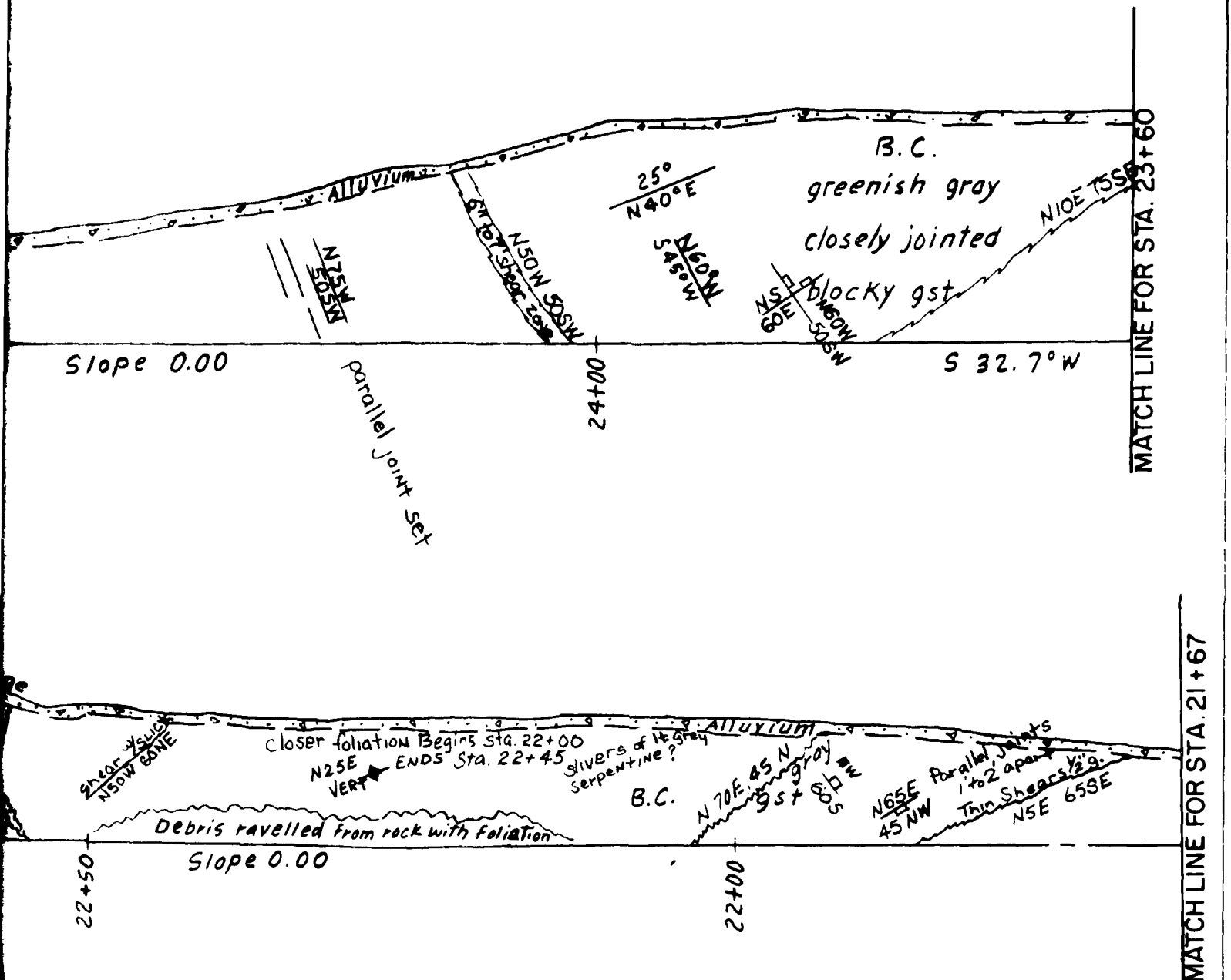


NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols

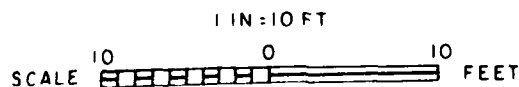


CORPS OF ENGINEERS



NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols



GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

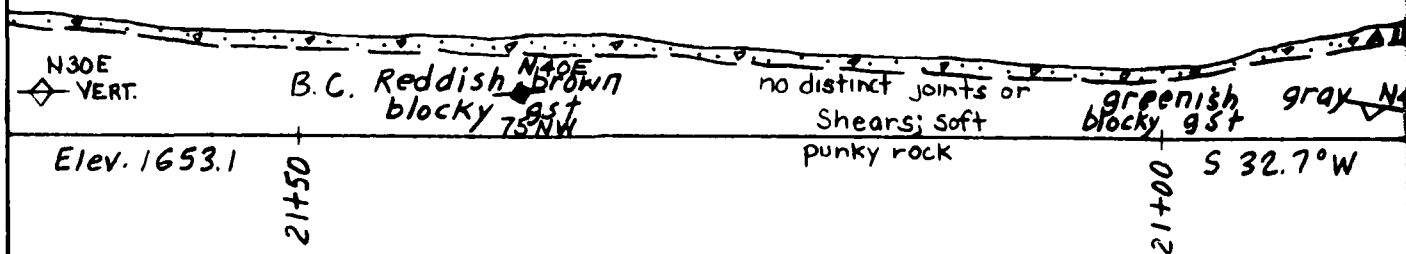
CAVE BUTTES DAM SPILLWAY GEOLOGY

EAST (LEFT) WALL OF SPILLWAY CUT
STA. 25+50 to STA. 21+67

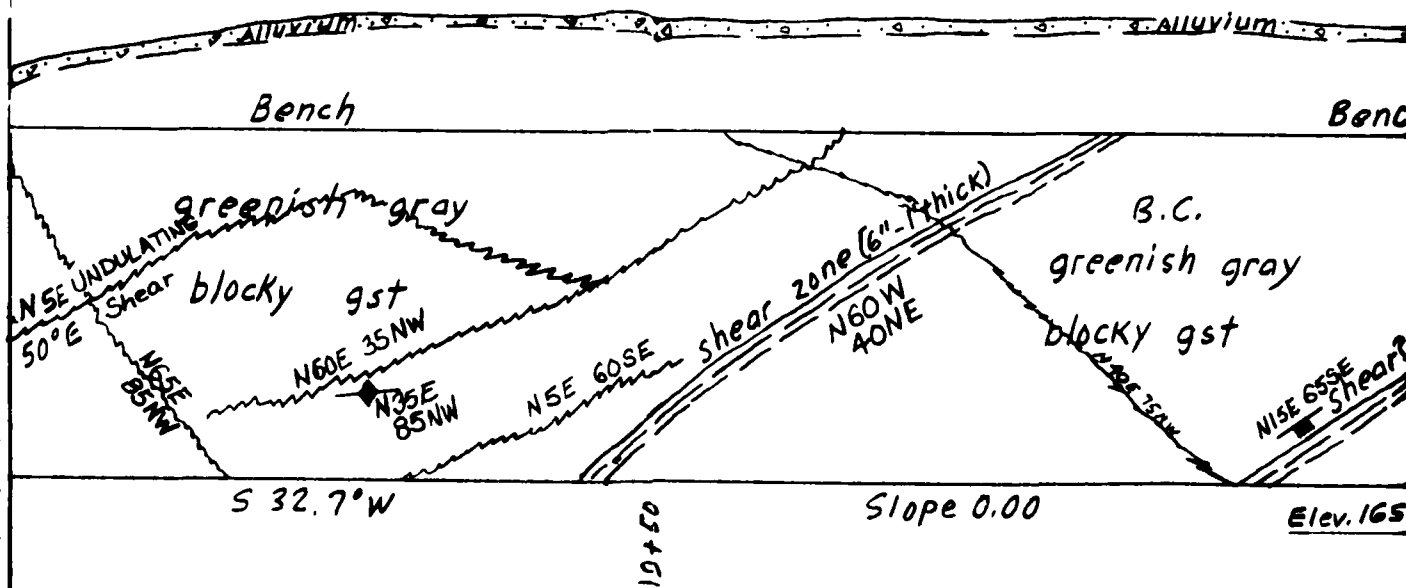
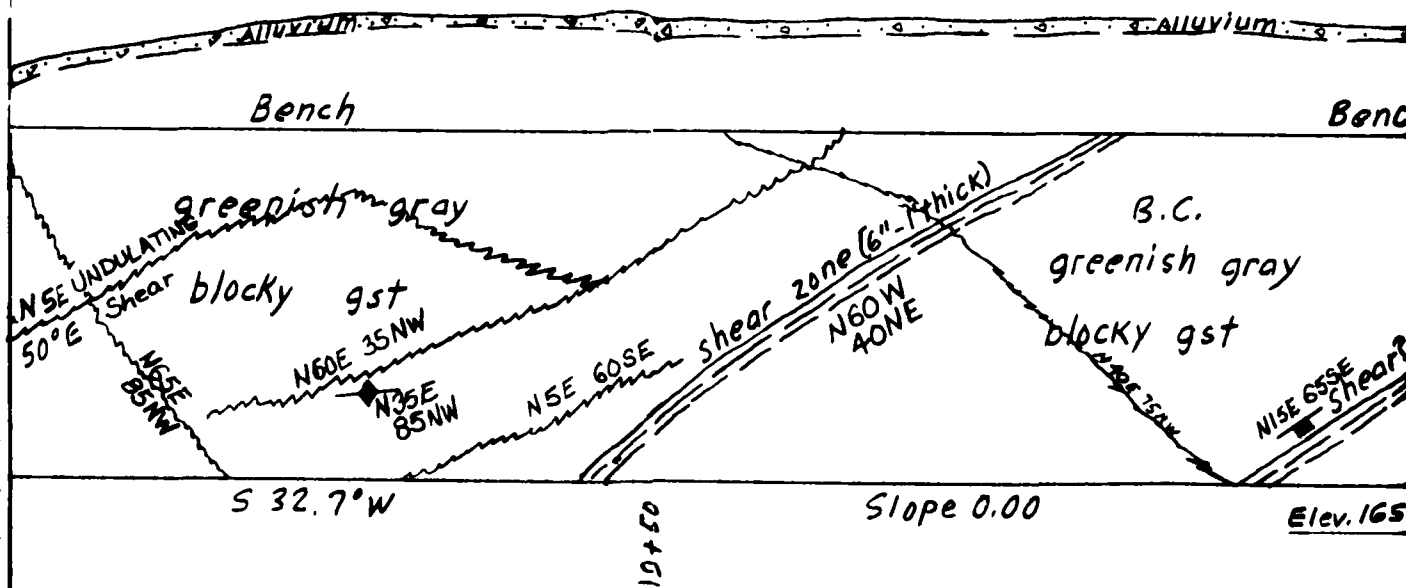
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

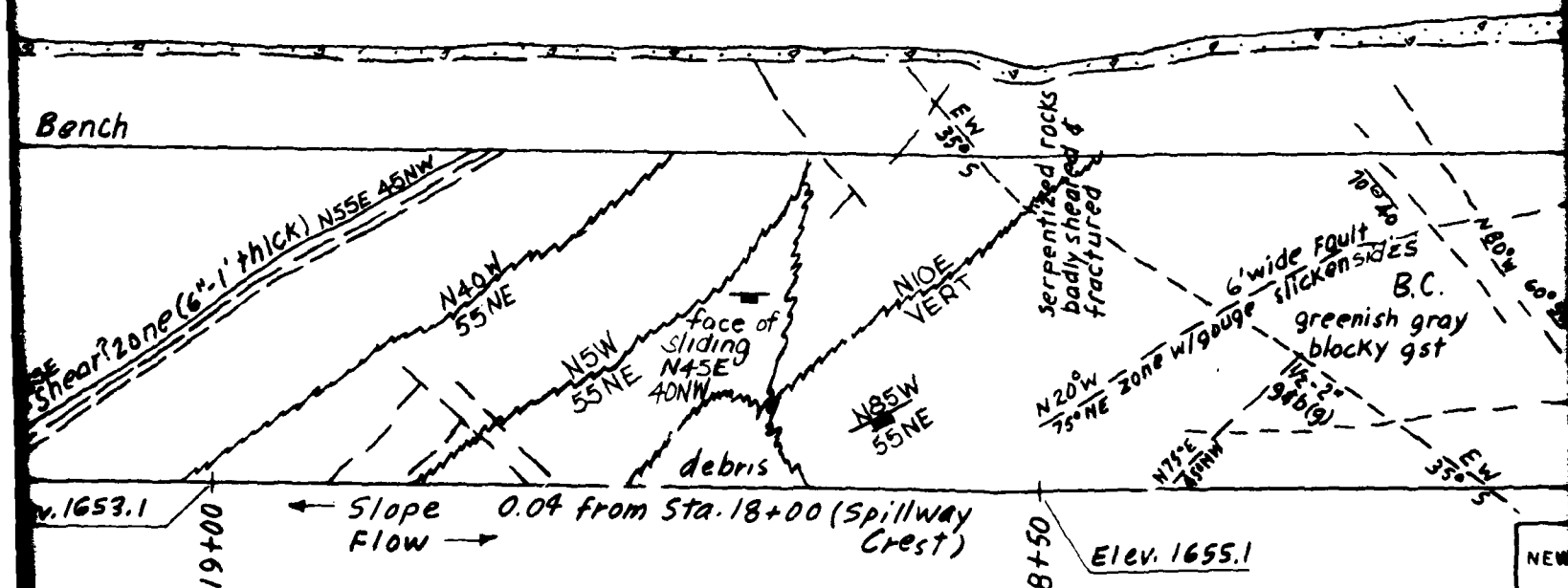
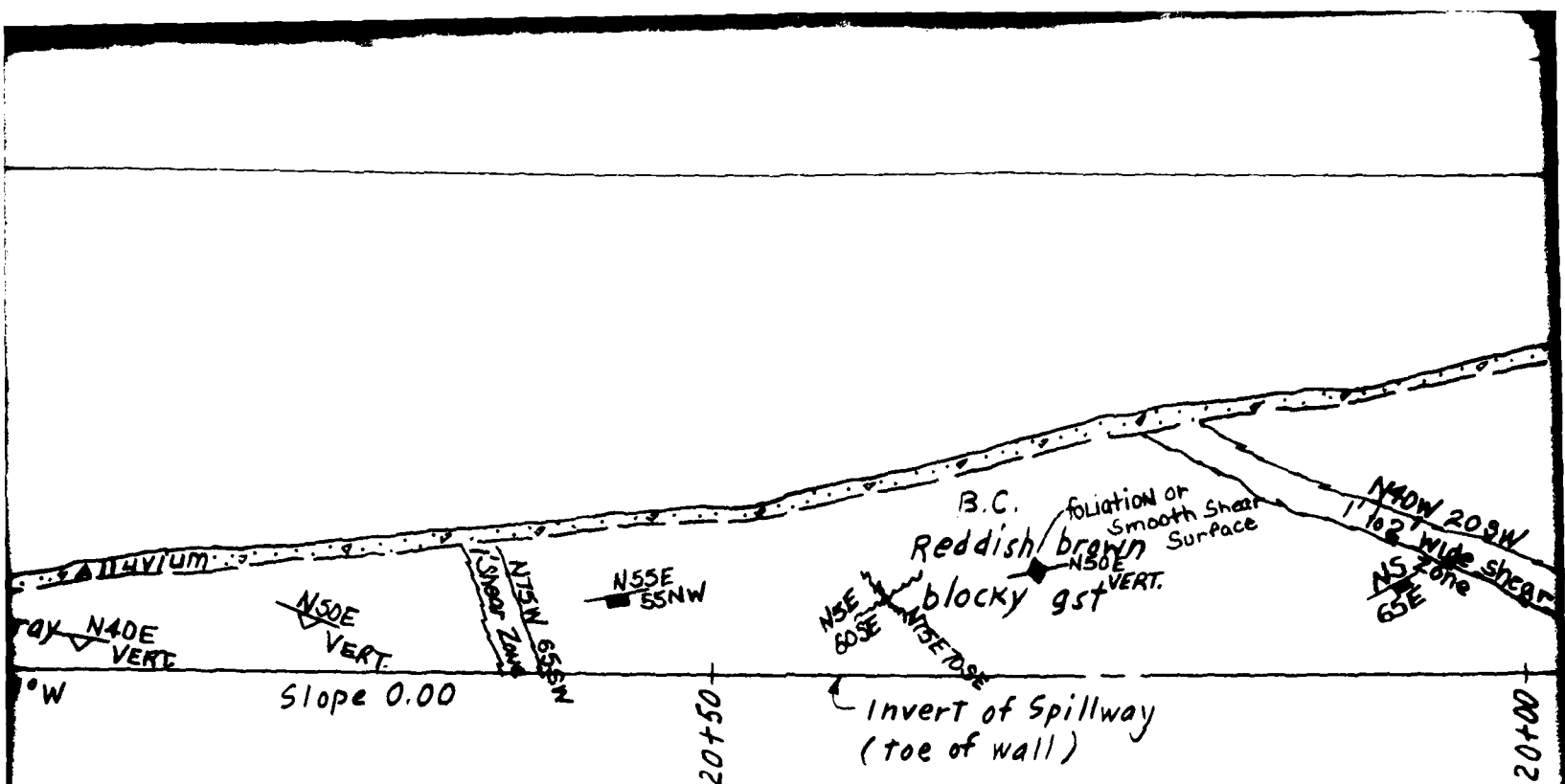
U.S. ARMY ENGINEER DISTRICT

MATCH LINE FOR STA. 21+67

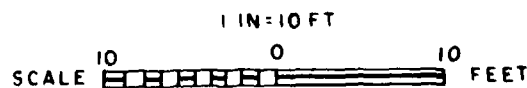


MATCH LINE FOR STA. 19+87

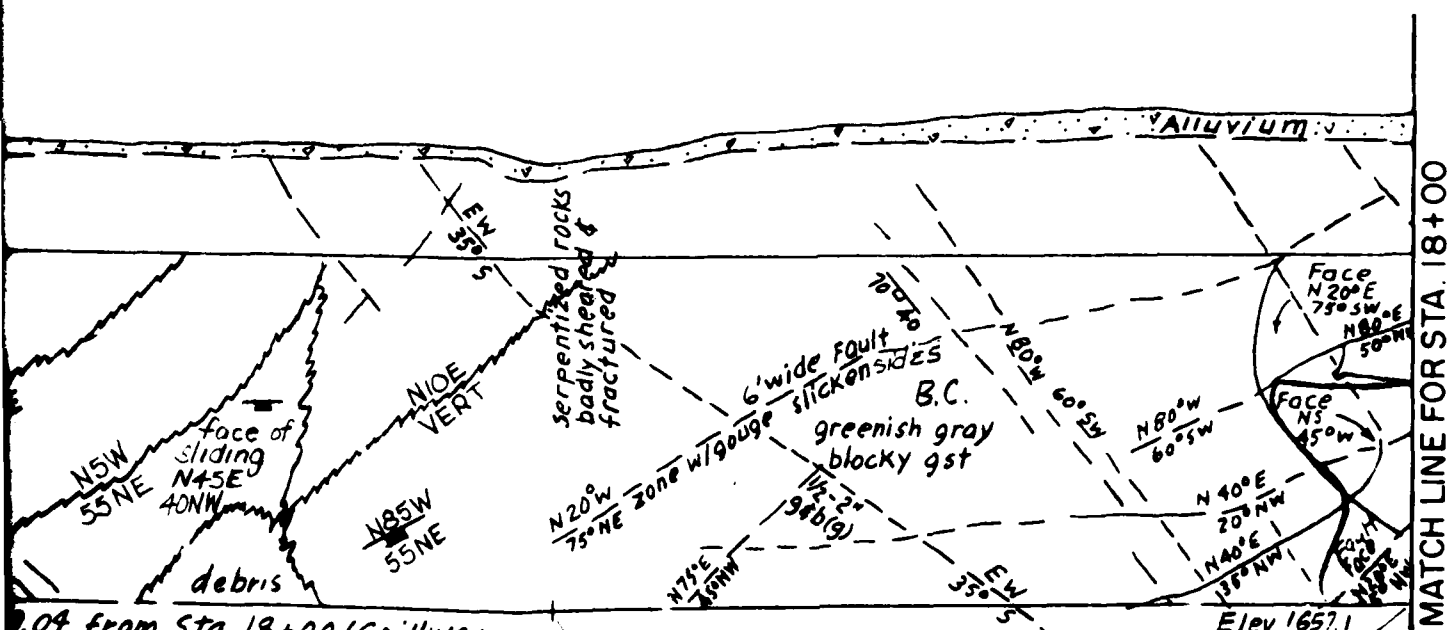
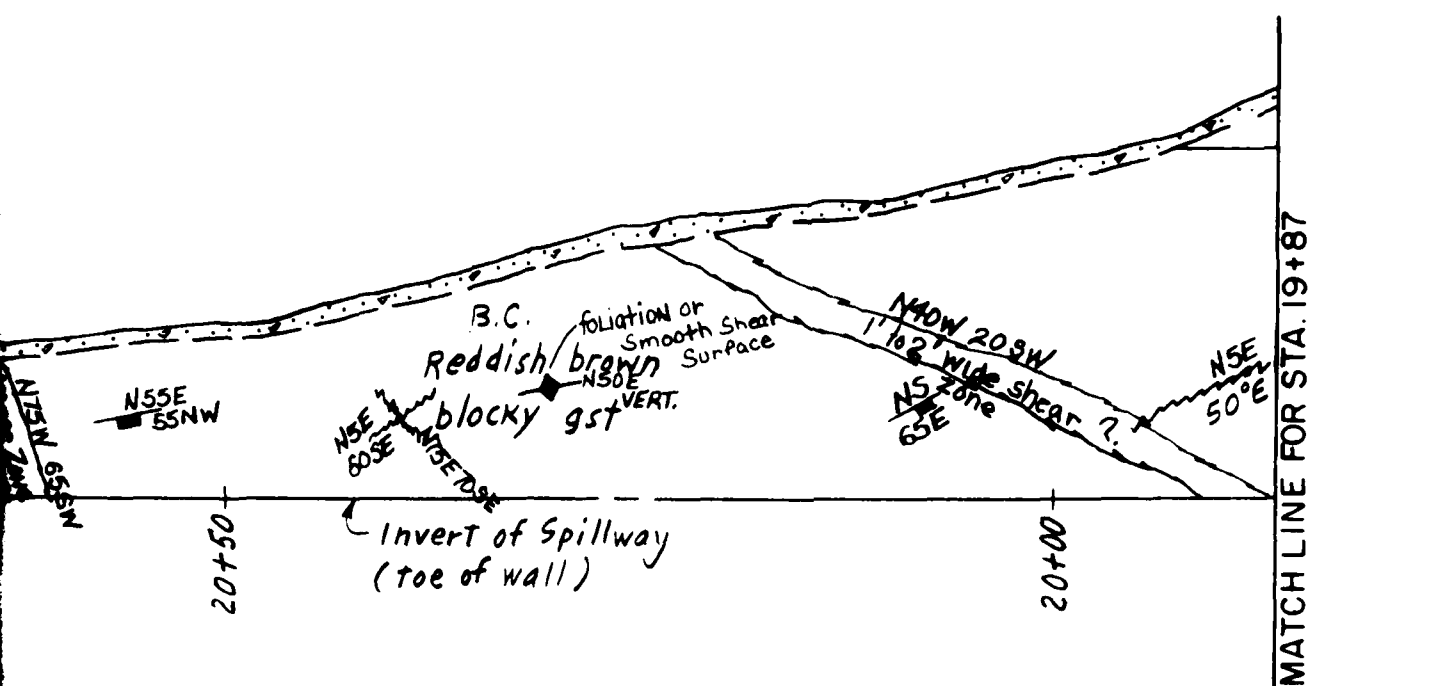




NOTE: Refer to Plate 24 for Rock descriptions and explanations of symbols



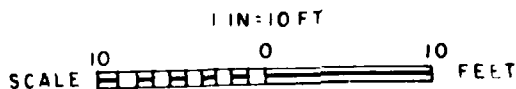
FOUNDAT



0.04 from Sta. 18+00 (Spillway Crest)

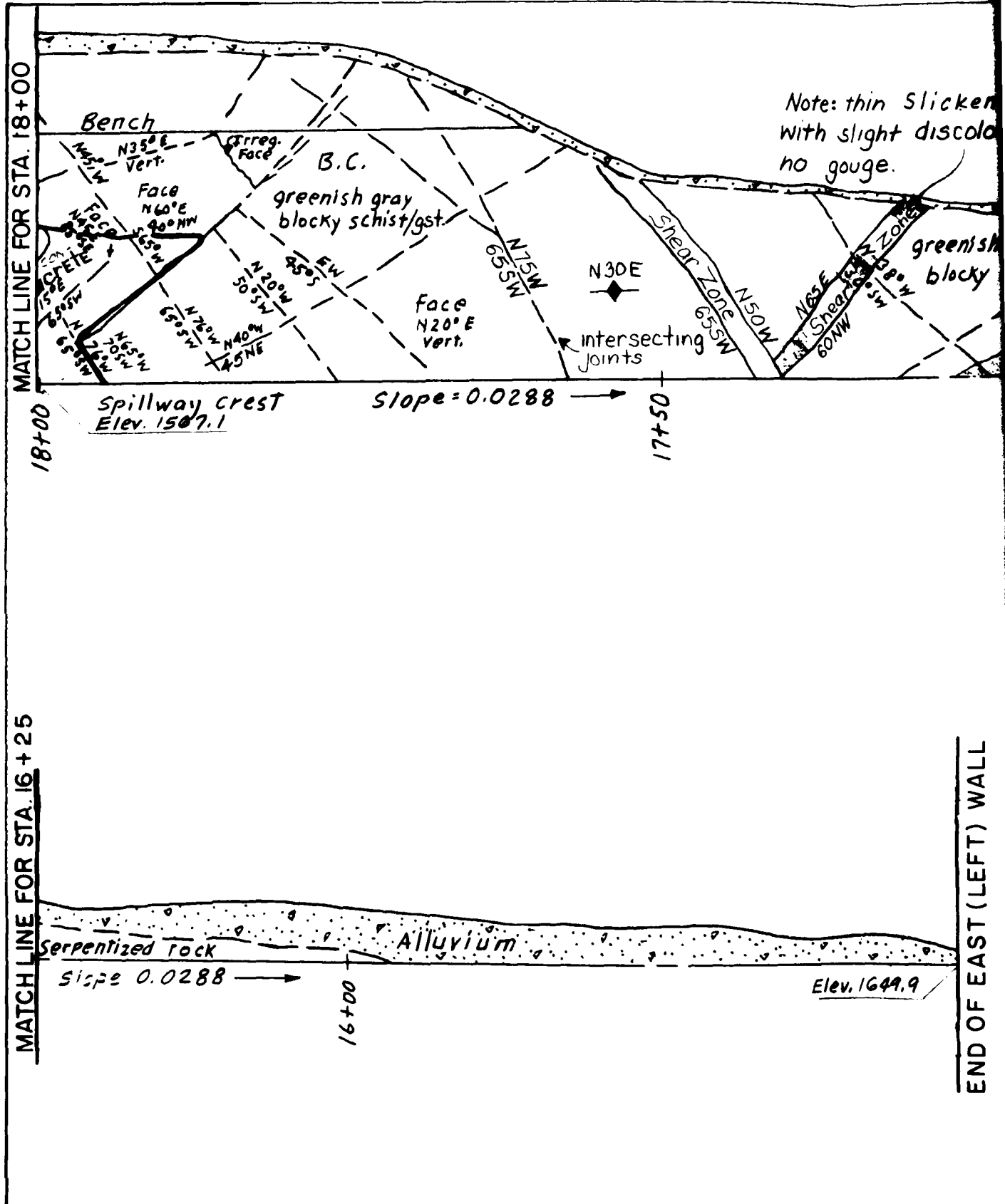
Elev. 1655.1

NOTE: Refer to Plate 24 for Rock descriptions and explanations of symbols



GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA
**CAVE BUTTES DAM
SPILLWAY GEOLOGY**
EAST (LEFT) WALL OF SPILLWAY CUT
STA. 21+67 to STA. 18+00
U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

U.S. ARMY ENGINEER DISTRICT

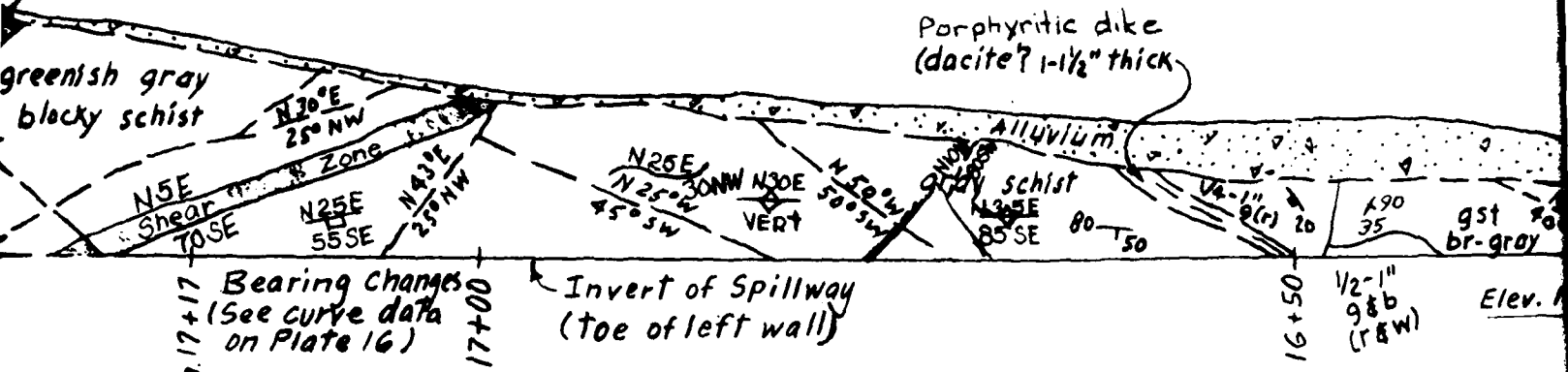


lickensides
discoloration-

Thin shear w/ 1/4 clayey gouge
at sta. 16+80 N25E 30NW

Porphyritic dike
(dacite? 1-1 1/2" thick)

greenish gray
blackish schist



End Curve Sta. 17+17

Bearing changes
(See curve data
on Plate 16)

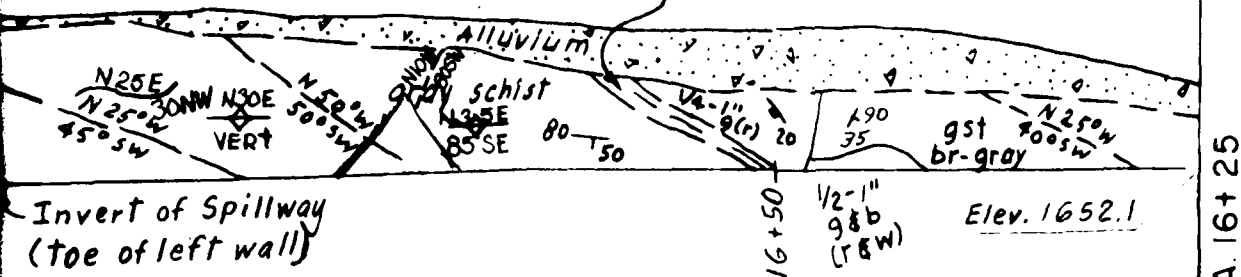
Invert of Spillway
(toe of left wall)

Note: From 1685-1710 thin deposits
of Fe bearing mineral (sample taken
hematite or limonite?) along shear N65°E &
45°NW; also vein of milky qtz ≈ 4' wide.

END OF EAST (LEFT) WALL

Thin shear w/ 1/4 clayey gouge
at sta. 16+80 N25E 30NW

Porphyritic dike
(dacite? 1-1 1/2" thick)



1710 thin deposits
mineral (sample taken
ite?) along shear N65E &
milky qtz = 4' wide.

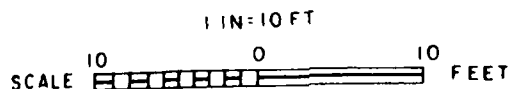
NOTE:

Refer to Plate 24 for Rock
descriptions and explanations
of symbols

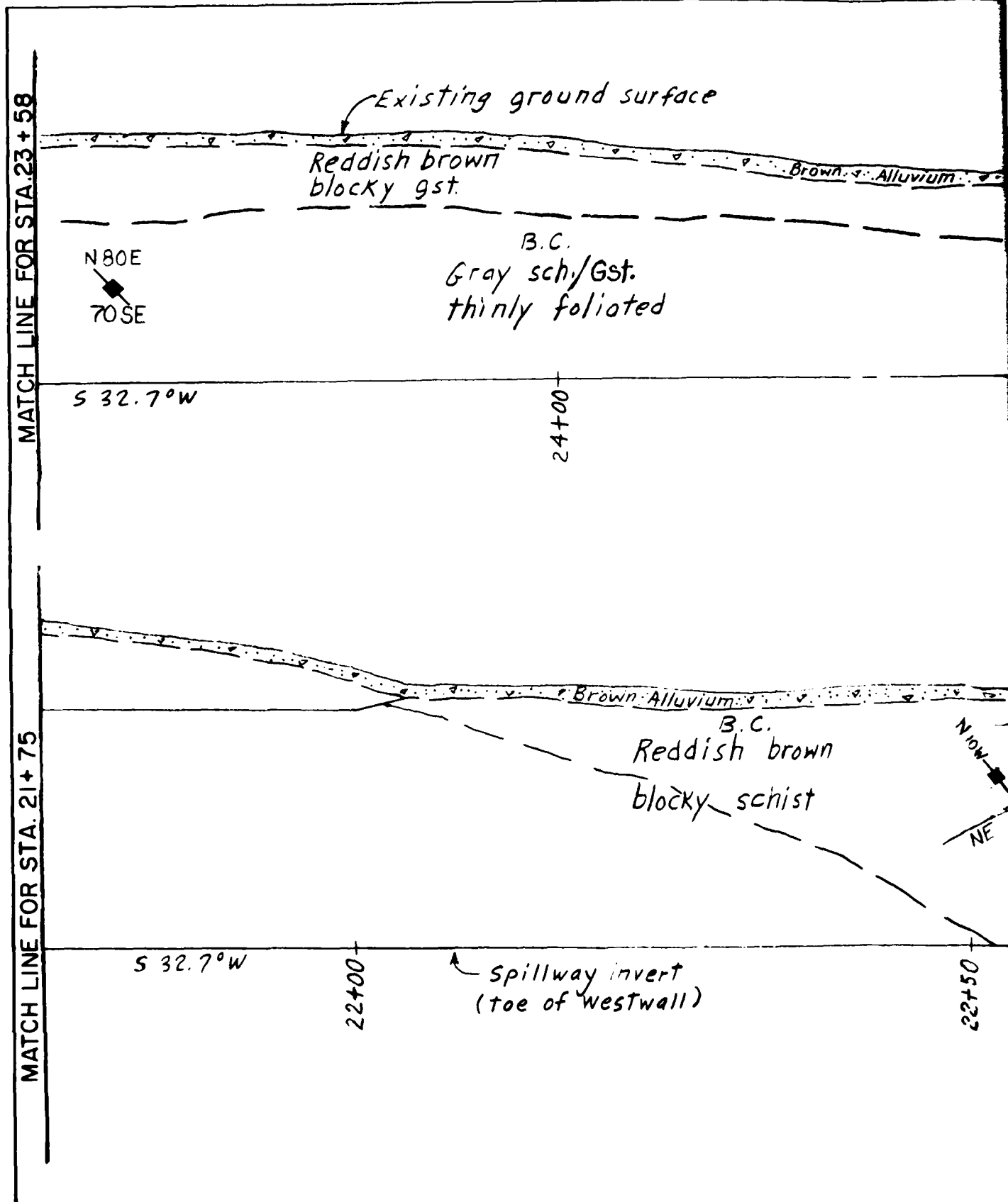
GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

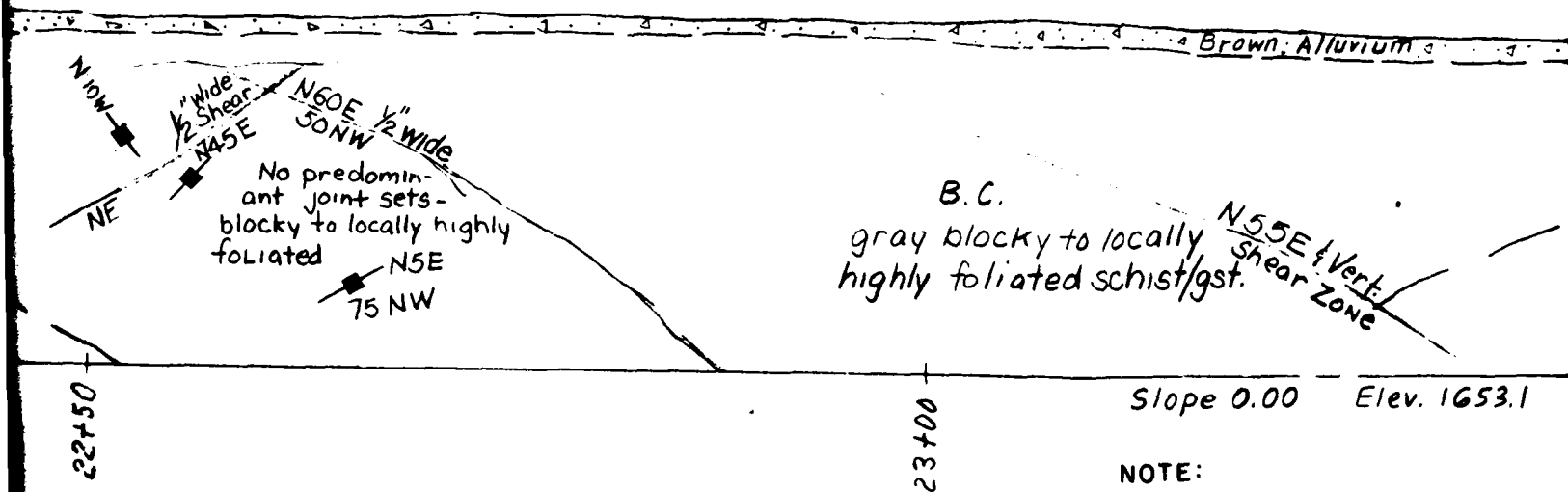
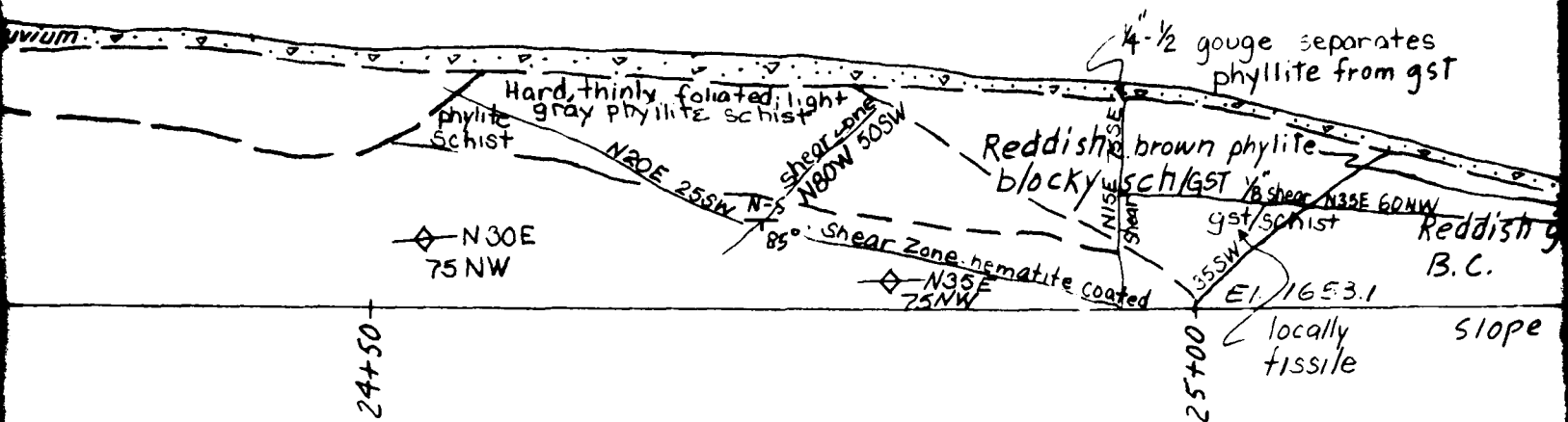
CAVE BUTTES DAM
SPILLWAY GEOLOGY
EAST (LEFT) WALL OF SPILLWAY CUT
STA. 18+00 to STA. 15+50

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:



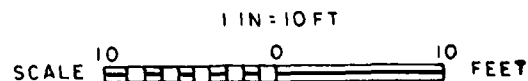
U.S. ARMY ENGINEER DISTRICT

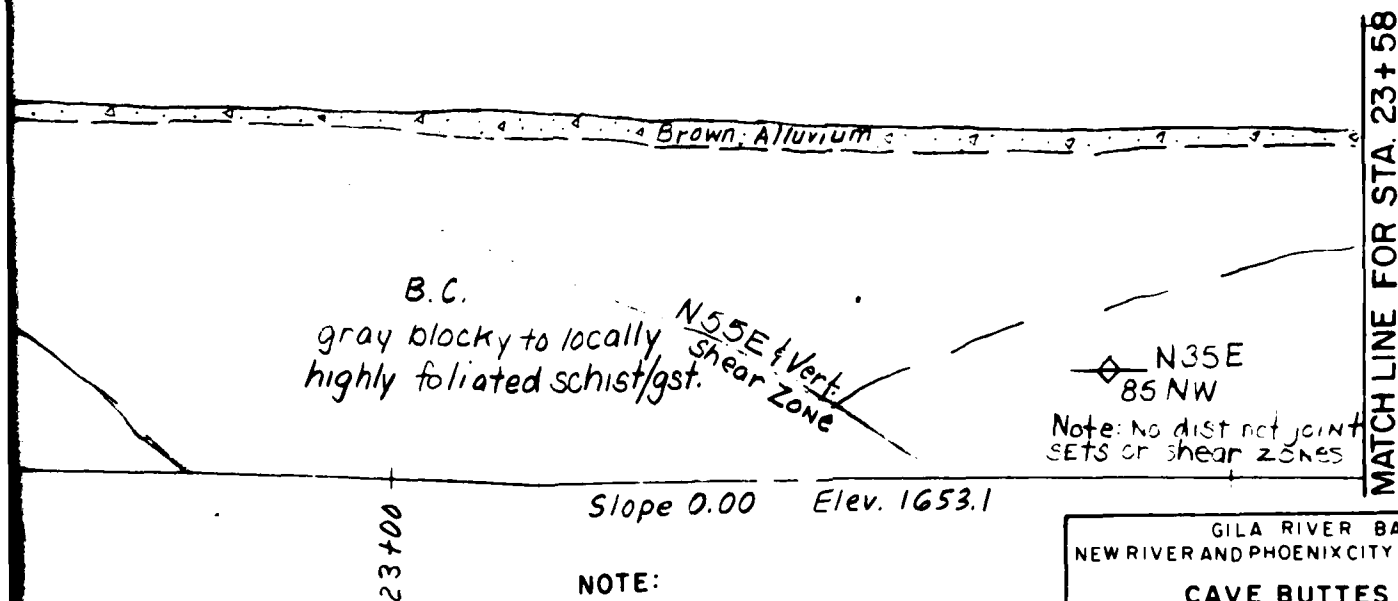
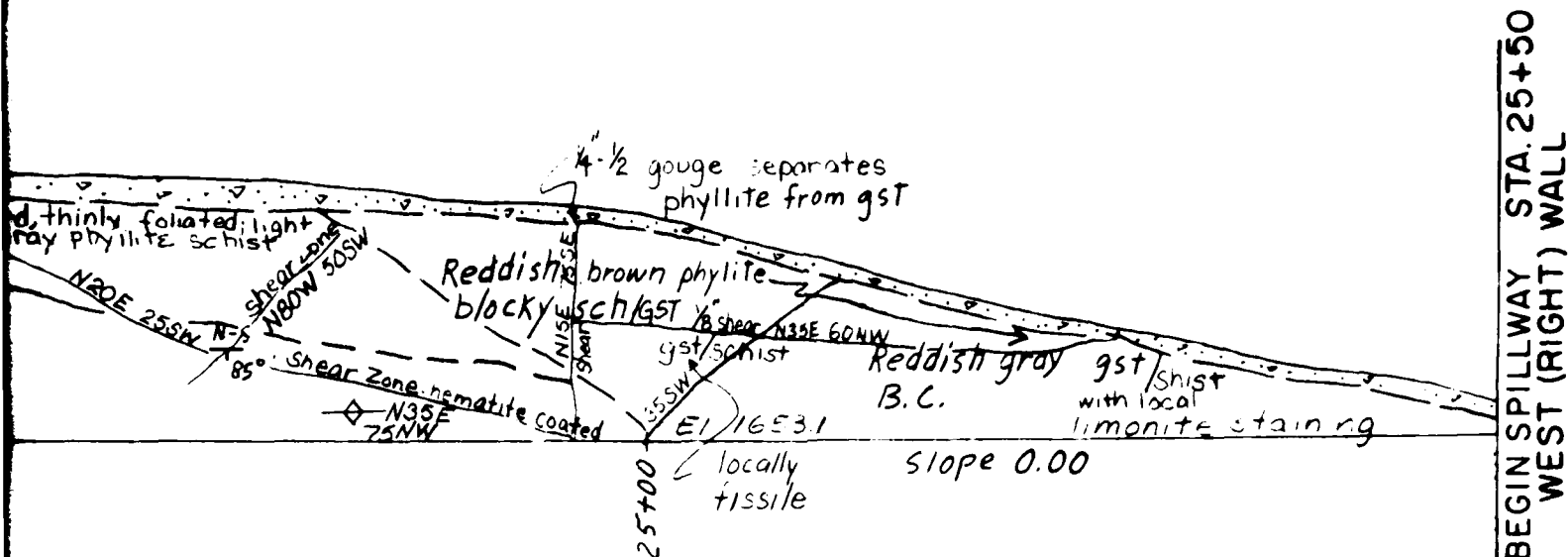




NOTE:

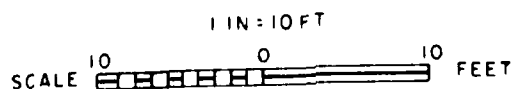
Refer to Plate 24 for Rock descriptions and explanations of symbols





NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols

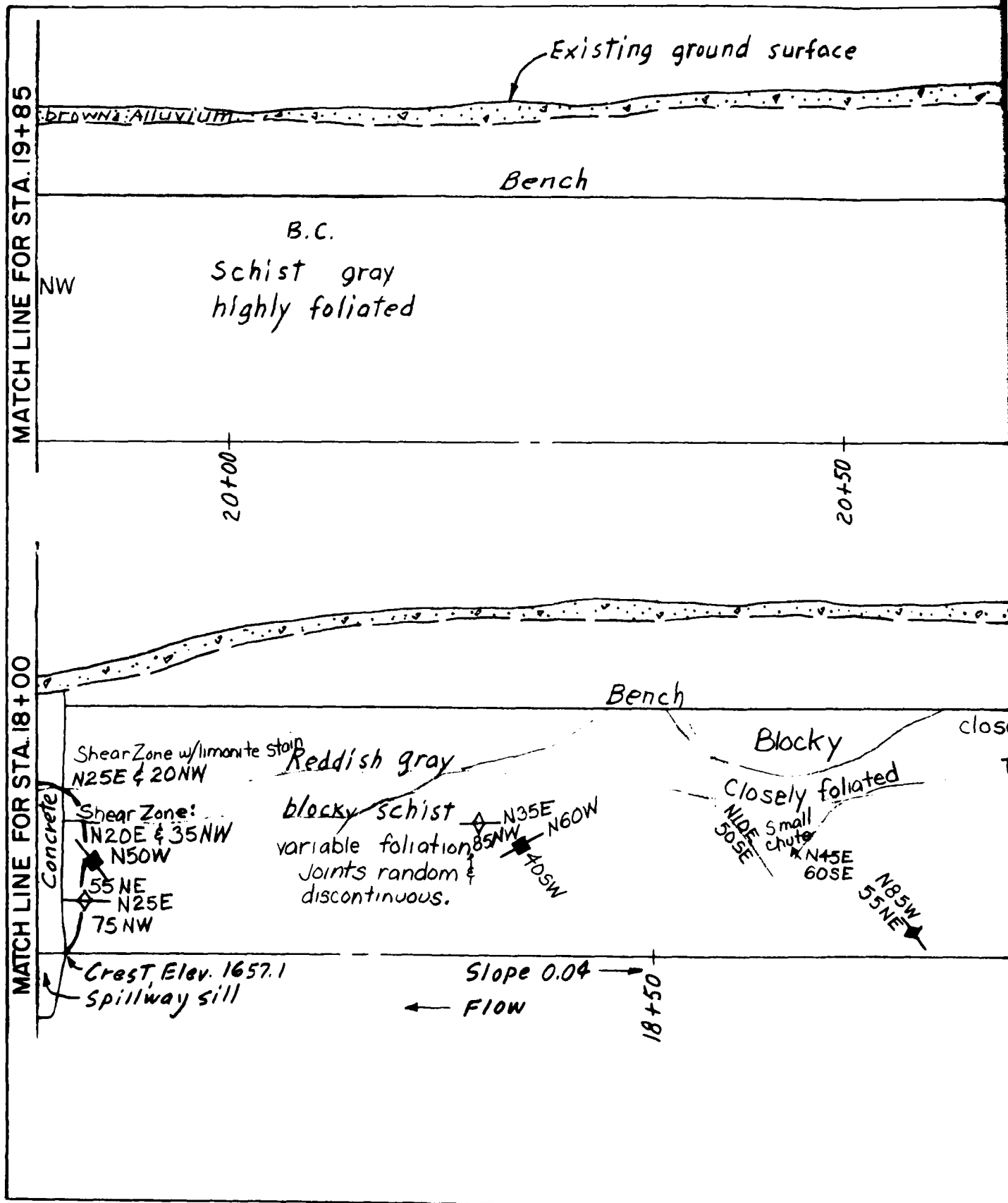


GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM
SPILLWAY GEOLOGY
WEST (RIGHT) WALL OF SPILLWAY
STA. 25+50 to STA. 21+75

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

U.S. ARMY ENGINEER DISTRICT



Reddish brown Alluvium

B.C.

Bench

N30°E
21° NW

Note: attitudes difficult
to measure due
to rubble

Flow

21+00

Reddish gray
blocky schist

Reddish b

closely
foliated
Thin shear

N35E
Vert.

gray blocky
schist -

moderate to highly
weathered & excavatable
by hand

blocky
schist

El. 1653.1

19+00
Slope
Change

Slope 0.00

19+50

NOTE:

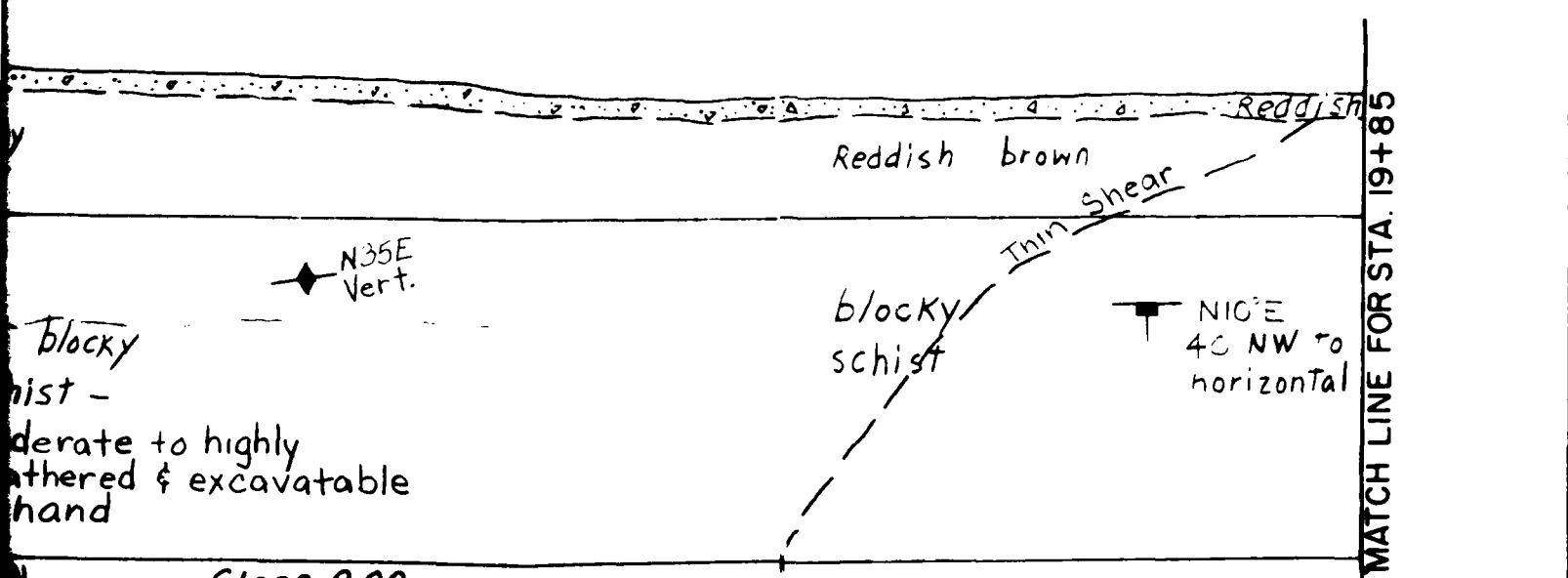
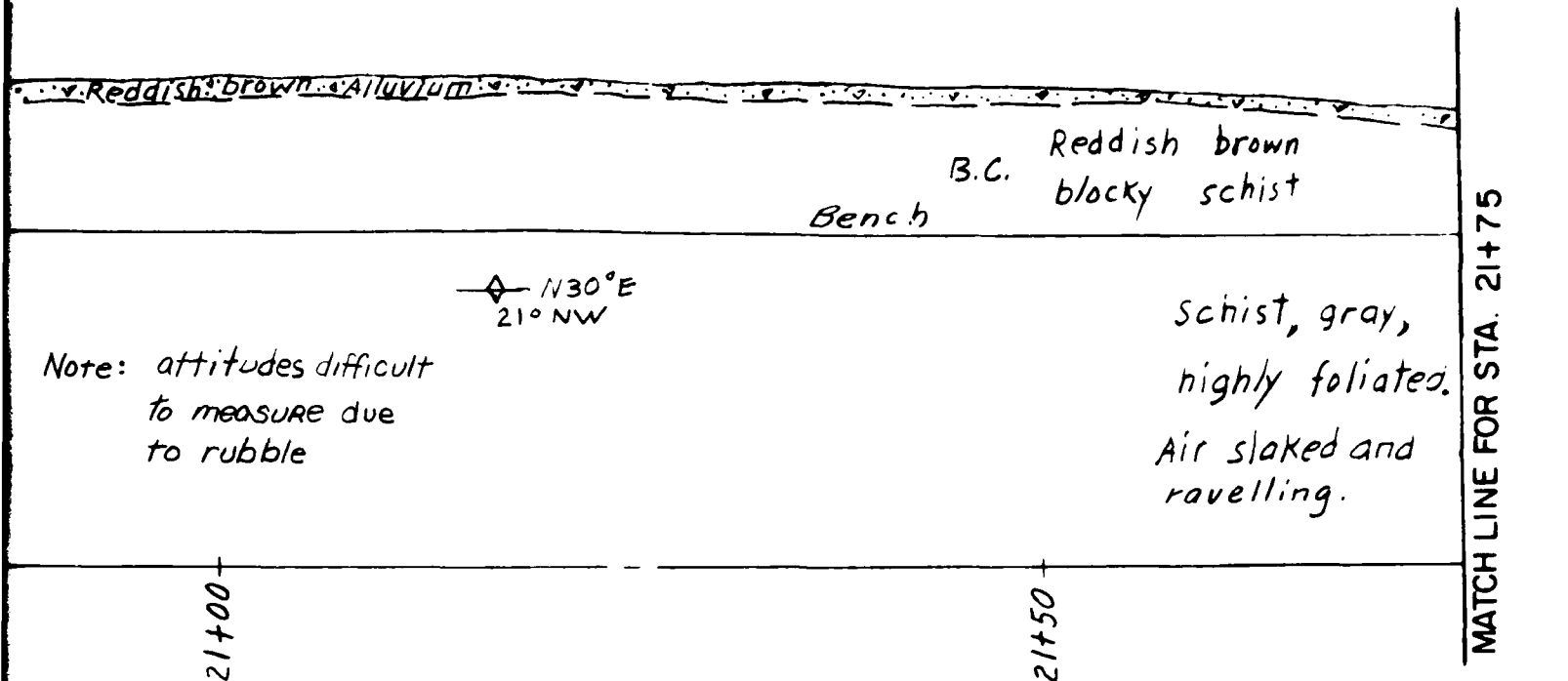
Refer to Plate 24 for Rock
descriptions and explanations
of symbols

1 IN = 10 FT

SCALE 10 0 10 FEET

FOU

2

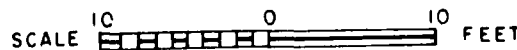


Slope 0.00

NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols

1 IN = 10 FT

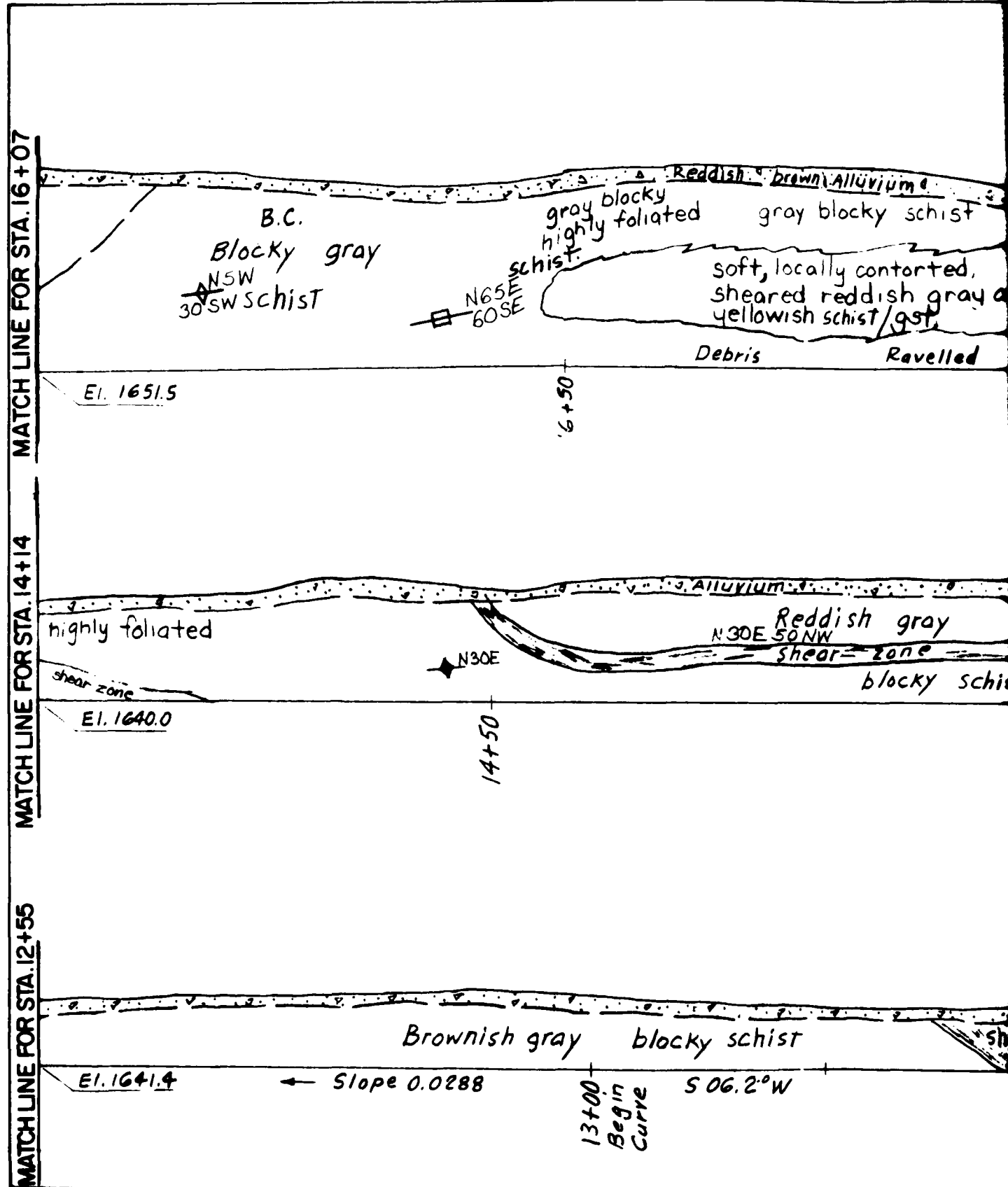


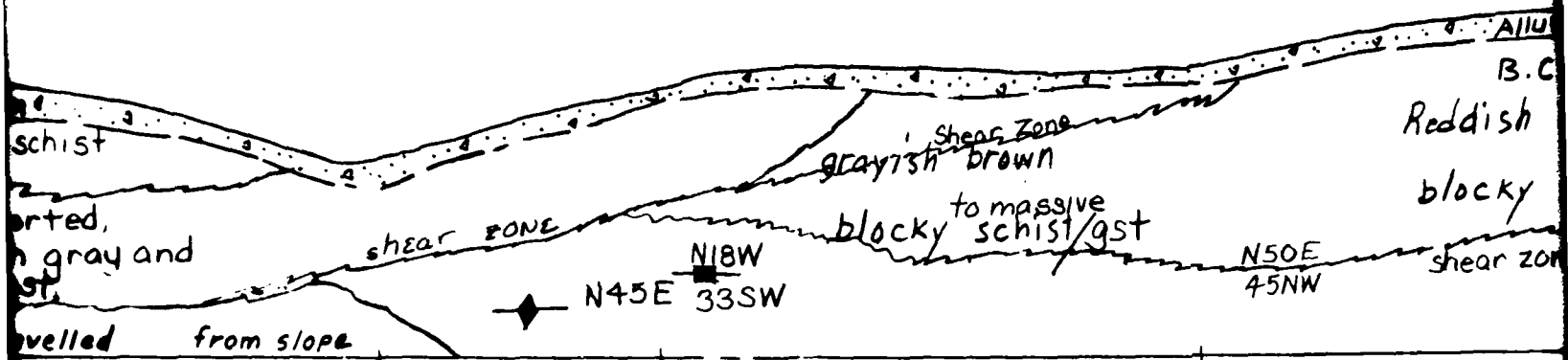
GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

CAVE BUTTES DAM
SPILLWAY GEOLOGY
WEST (RIGHT) WALL OF SPILLWAY
STA. 21+75 to STA. 18+00

U. S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

U.S. ARMY ENGINEER DISTRICT



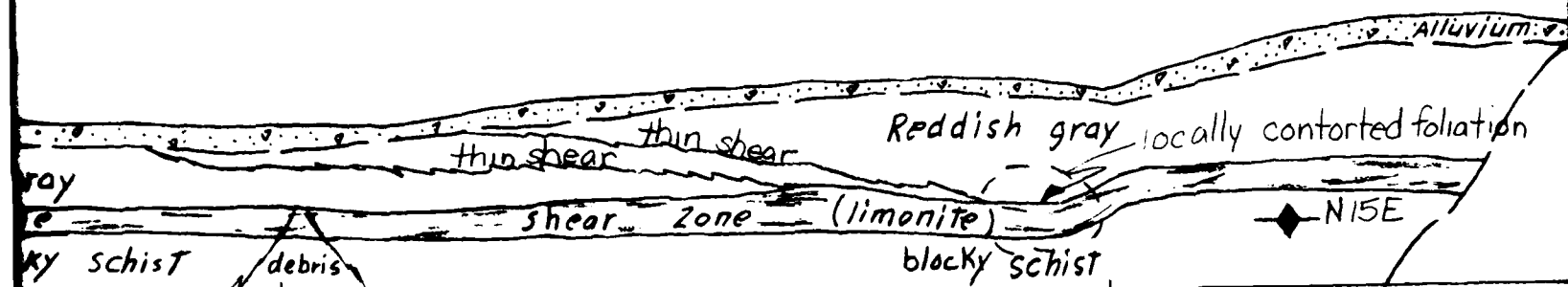


N45E 33SW

N50E 45NW

S 32.7° W

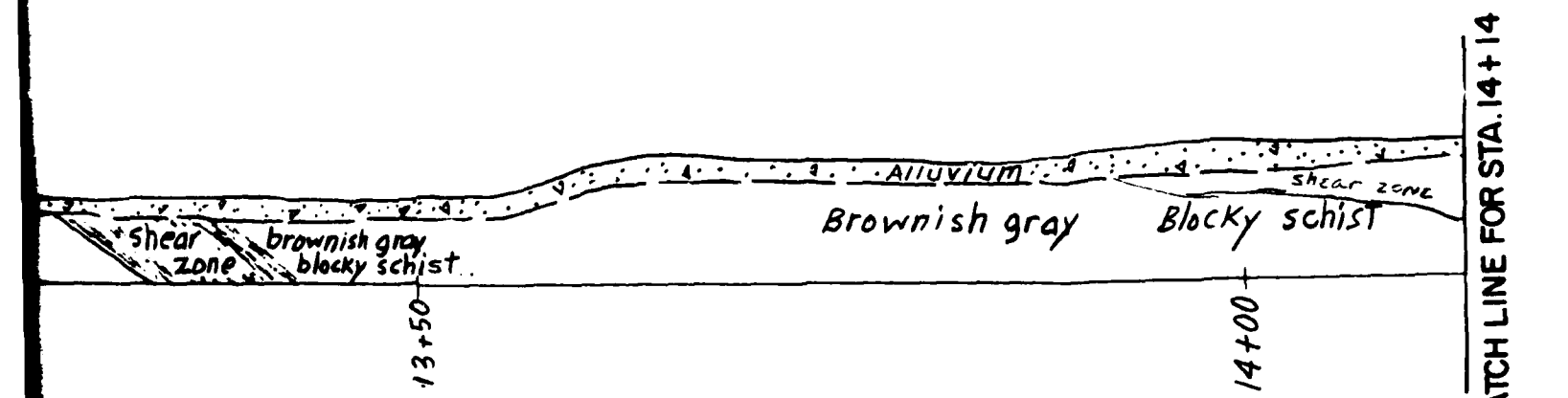
← Slope 0.0
← Flow



15+00

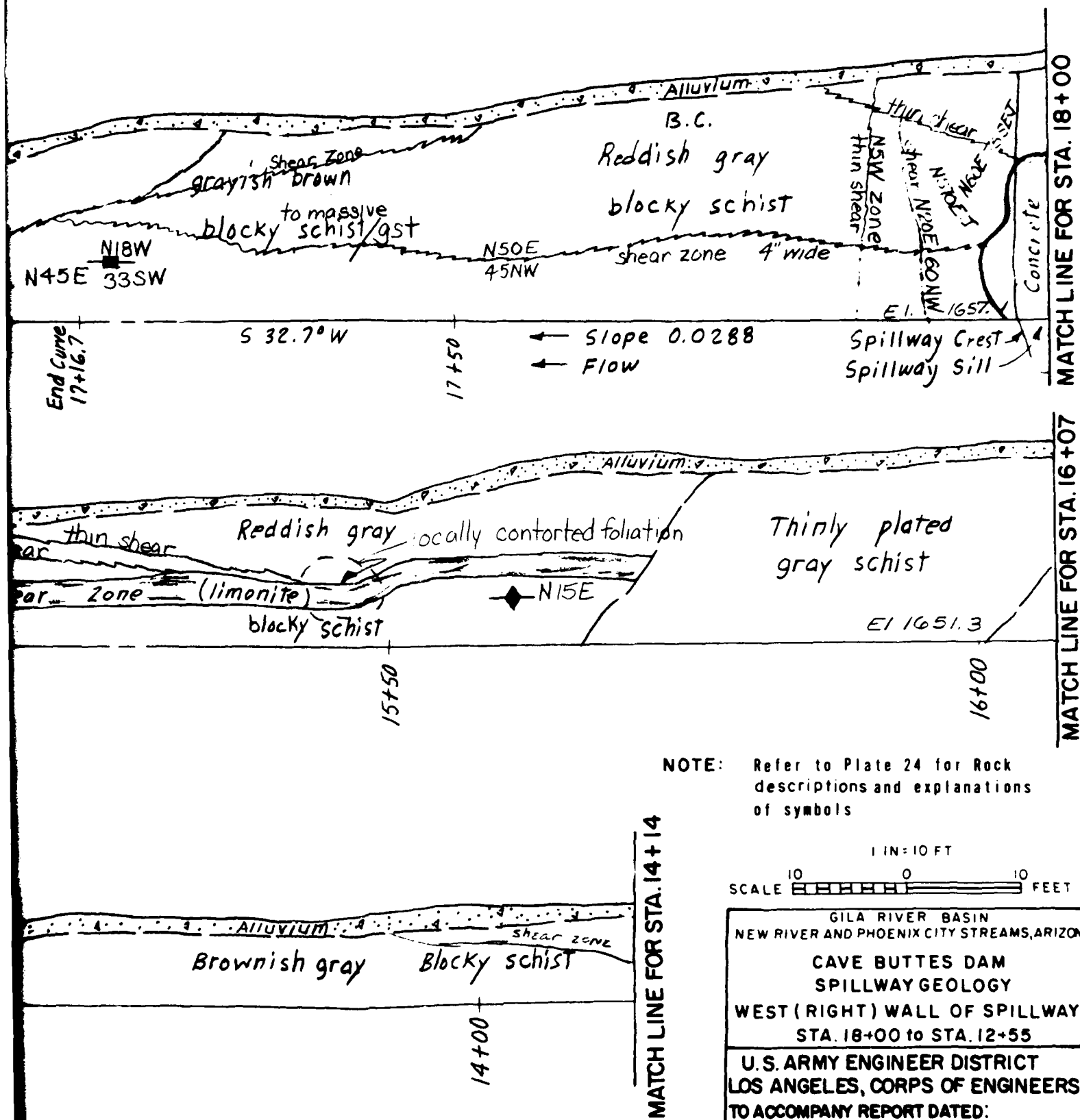
15+50

NOTE



13+50

14+00



U.S. ARMY ENGINEER DISTRICT

MATCH LINE FOR STA. 9+56 MATCH LINE FOR STA. 11+02

E1. 1636.9

Qoal

Brownish Alluvium

11+50

B.C. Greenish gray

EW 455

N30E blocky schist

80NW

10+00

END OF WEST (RIGHT) WALL

2-3" g&b(r)
75
35

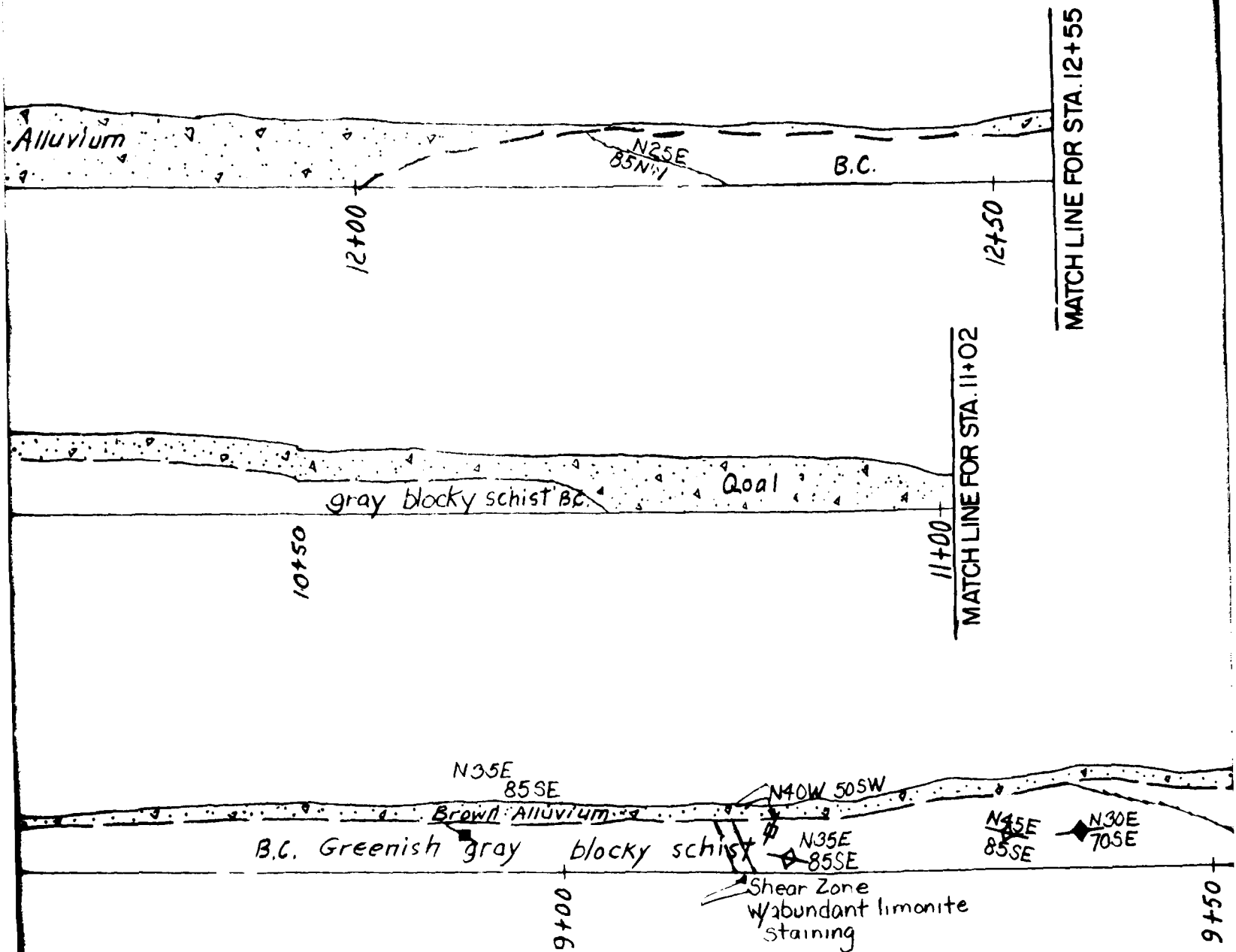
1-2" g(r)
25
60

Alluvium

B.C. gst (serpentinized) green, hard

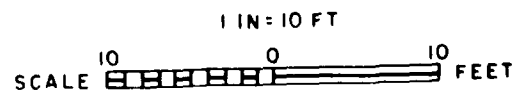
N35E
80SE

8+50

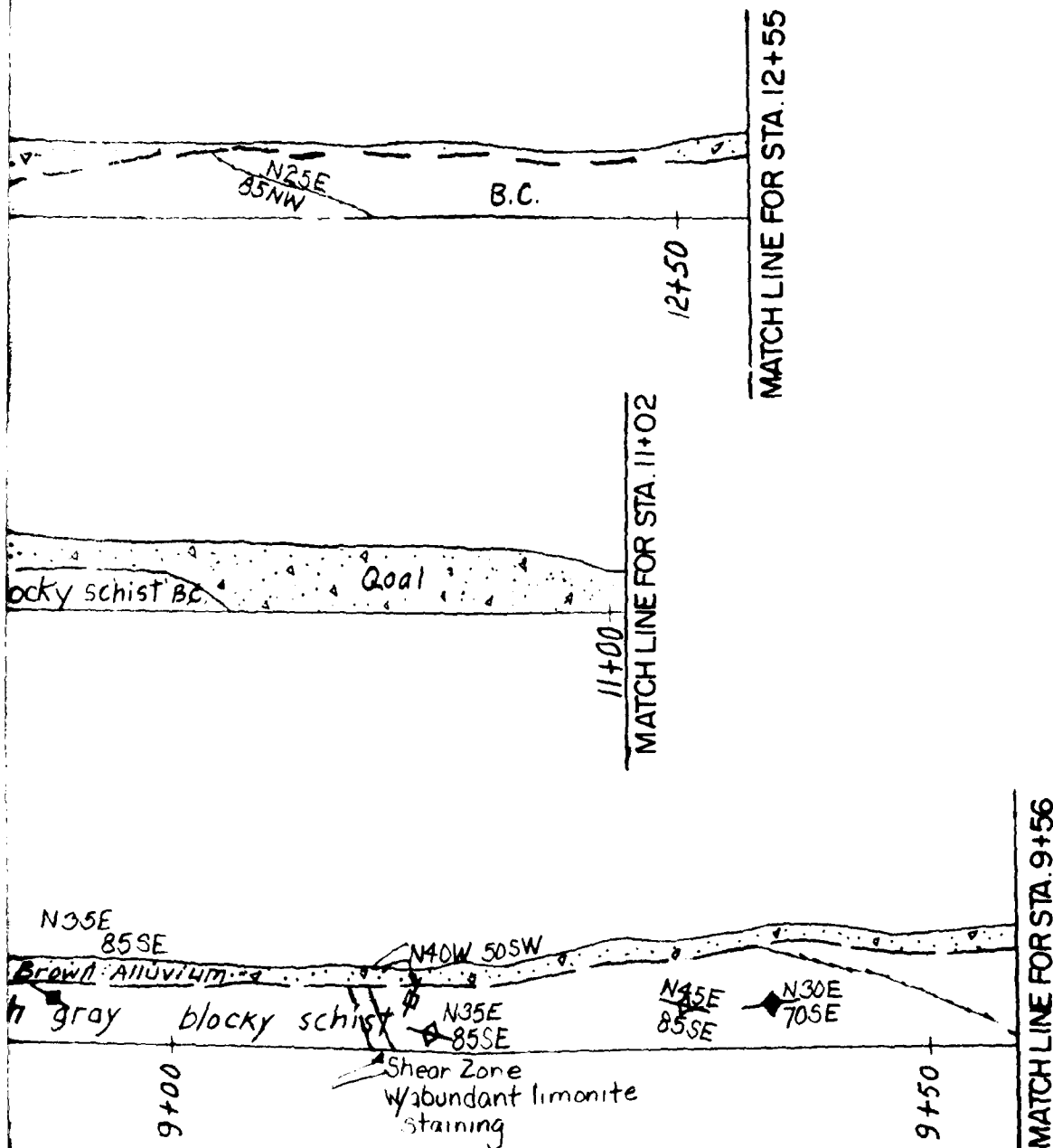


NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols

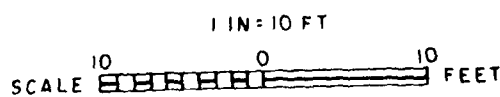


CORPS OF ENGINEERS



NOTE:

Refer to Plate 24 for Rock descriptions and explanations of symbols



GILA RIVER BASIN
NEW RIVER AND PHOENIX CITY STREAMS, ARIZONA

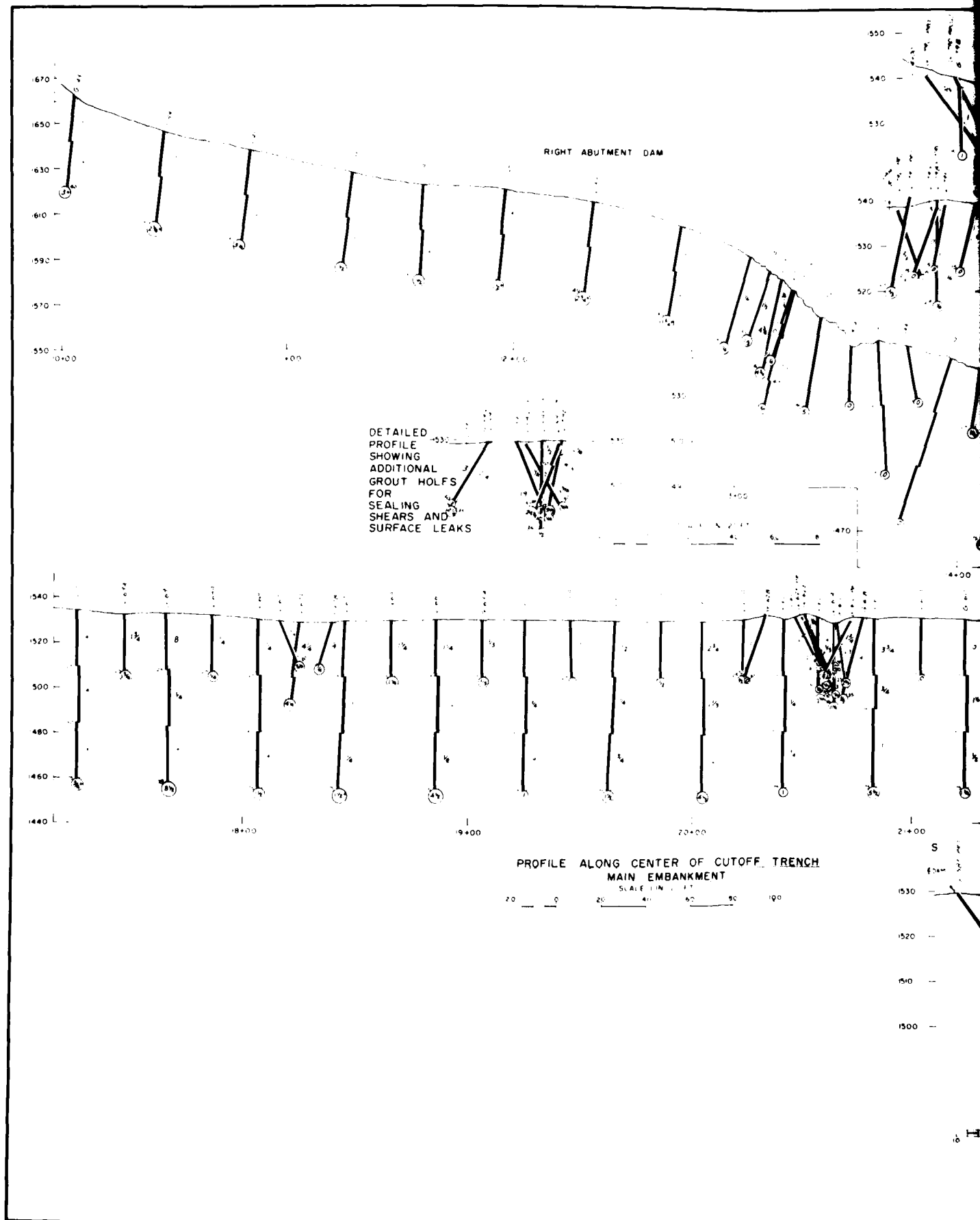
CAVE BUTTES DAM SPILLWAY GEOLOGY

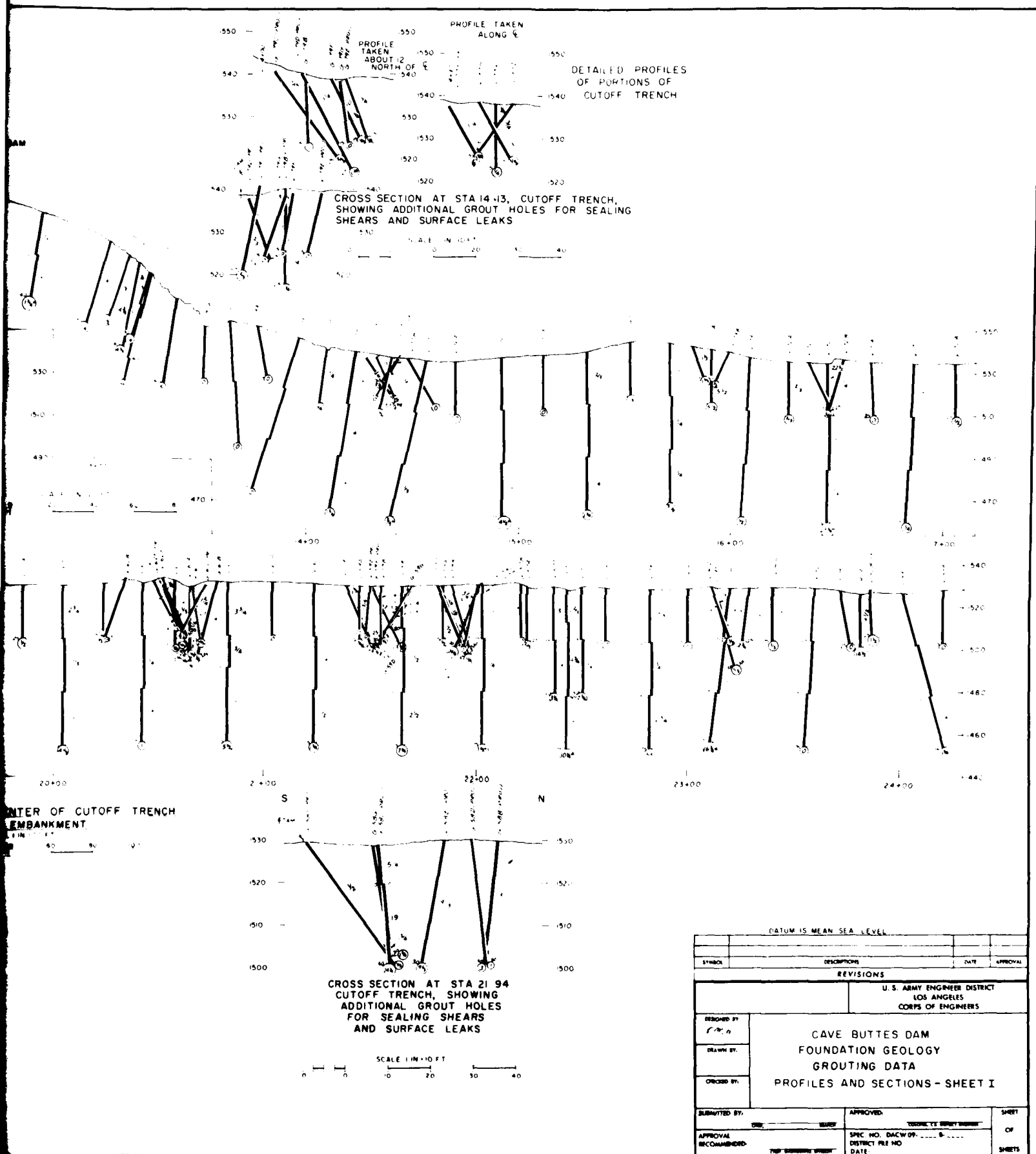
WEST (RIGHT) WALL OF SPILLWAY
STA. 12+55 to STA. 8+00

U.S. ARMY ENGINEER DISTRICT
LOS ANGELES, CORPS OF ENGINEERS
TO ACCOMPANY REPORT DATED:

FOUNDATION REPORT

PLATE 56



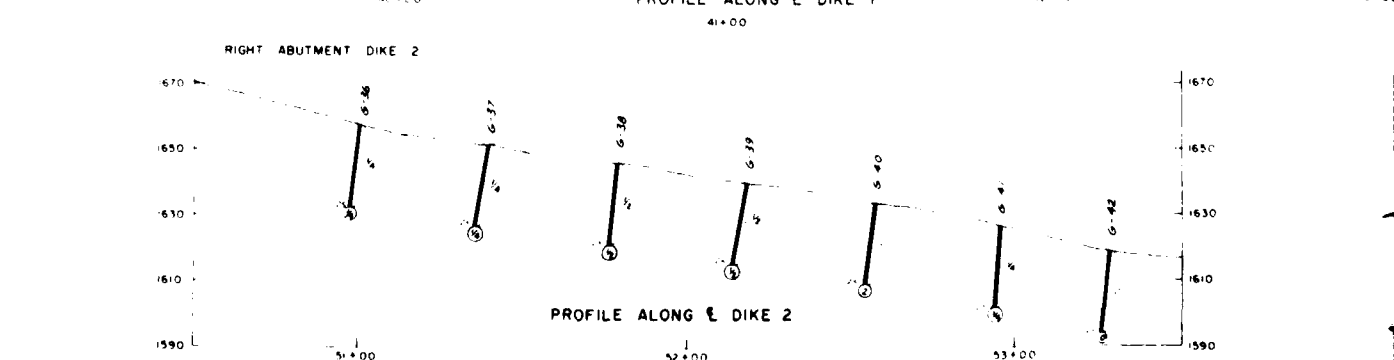
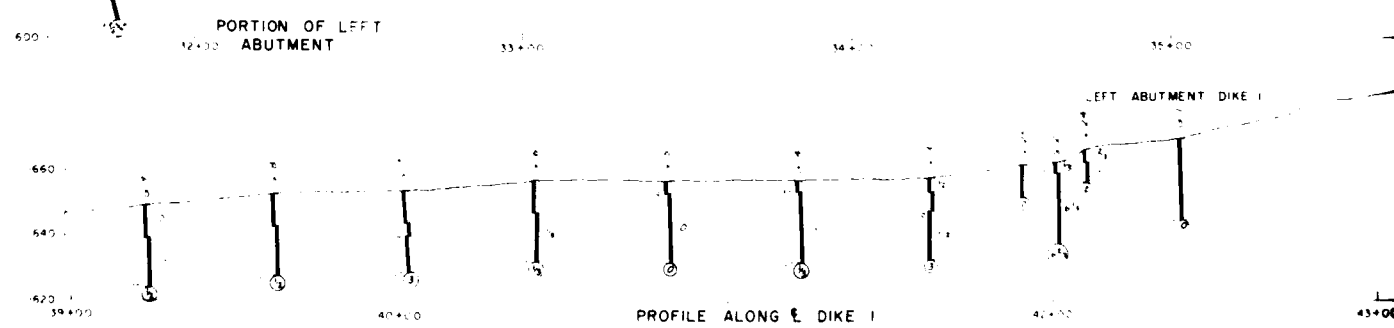
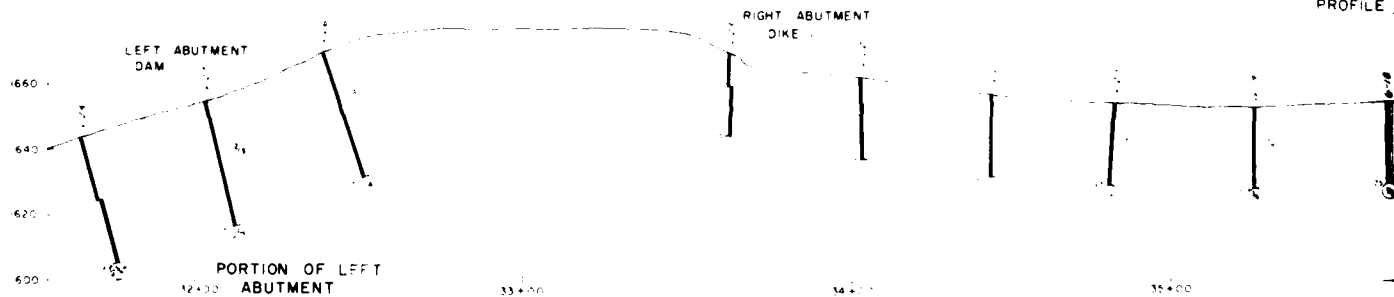
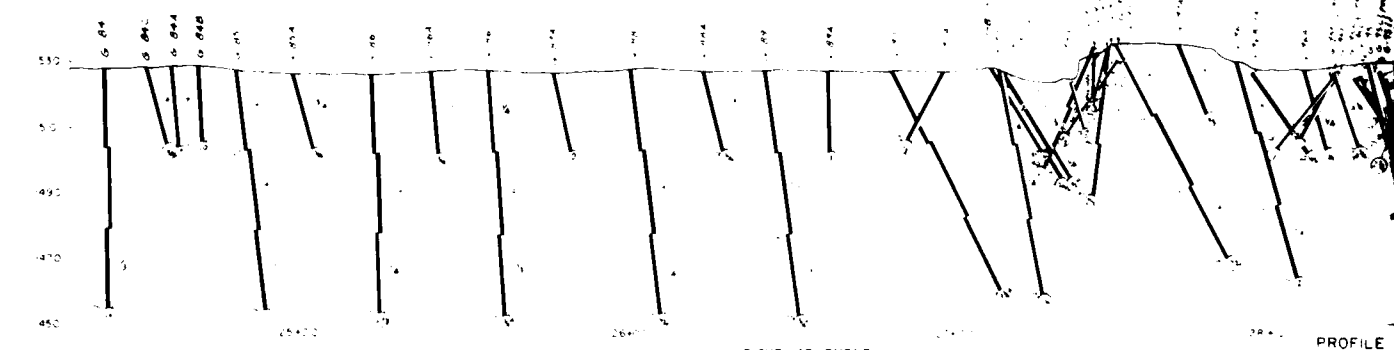


N
Outlet works
conduit

560

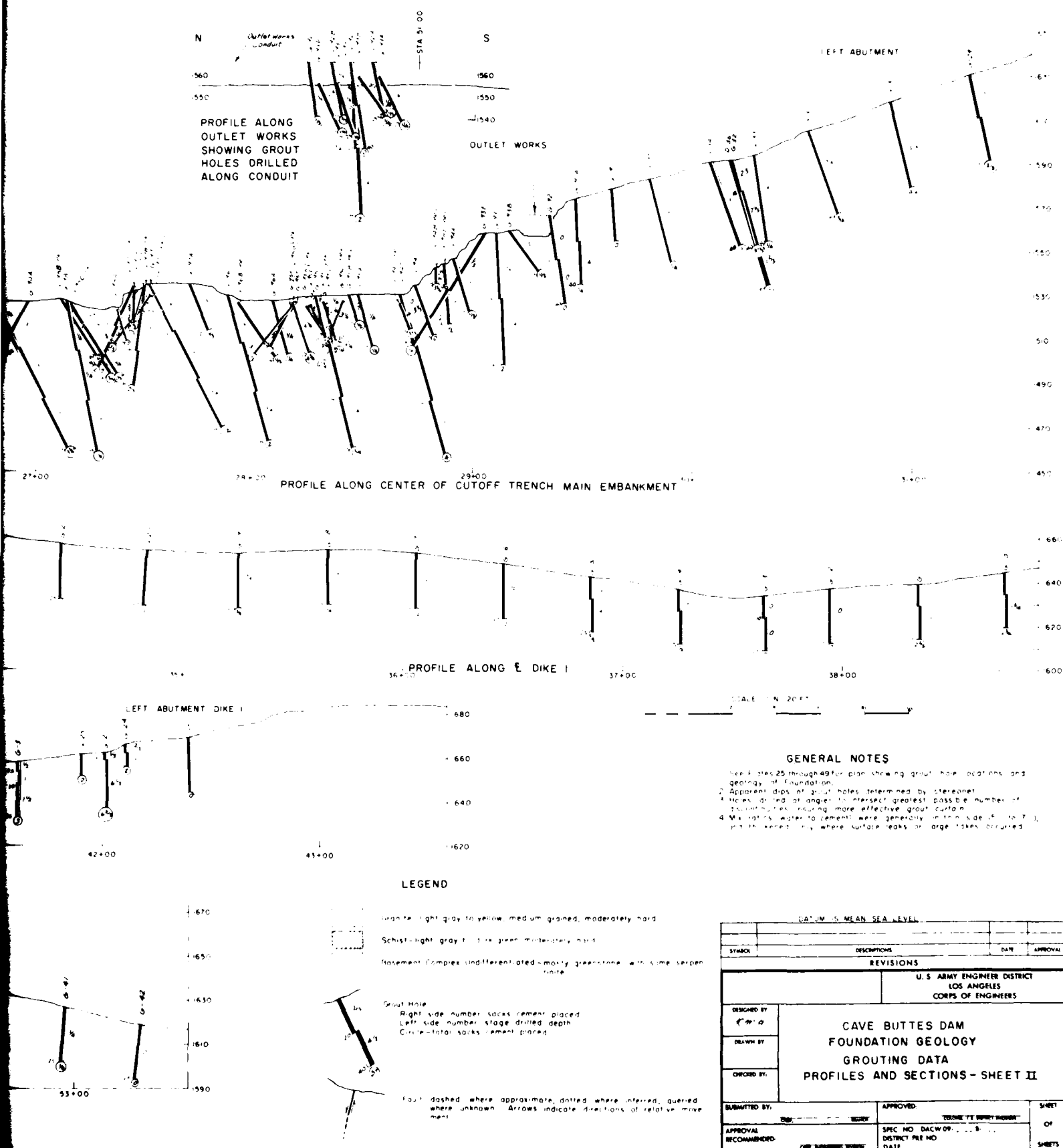
550

PROFILE ALONG
OUTLET WORKS
SHOWING GROUT
HOLES DRILLED
ALONG CONDUIT



PROFILE ALONG DIKE 2

PROFILE ALONG DIKE 1



DATE: 11-1-54			
SYMBOL	DESCRIPTIONS	DATE	APPROVAL
REVISIONS			
U.S. ARMY ENGINEER DISTRICT LOS ANGELES CORPS OF ENGINEERS			
DESIGNED BY: C. W. A.	CAVE BUTTES DAM FOUNDATION GEOLOGY GROUTING DATA PROFILES AND SECTIONS - SHEET II		
DRAWN BY:			
CHECKED BY:			
SUBMITTED BY:	APPROVED:	SHEET	
APPROVAL RECOMMENDED:	SPEC. NO. DACW 09-1-54	OF	
DATE		SHEETS	

ATTACHED

CONTRACT QUANTITIES AND COSTS - CAVE BUTTES DAM

Item No.	Description	Estimated Quantity	Final Quantity	Unit	Unit Price	Total Amount
1	Diversion and Control of Water	1	100%	Job	L.S.	\$ 60,000.00
1-A	Mobilization and Preparatory Work	1	100%	Job	L.S.	530,000.00
2	Clearing and Grubbing	1	100%	Job	L.S.	200,000.00
3	Stripping	299,000	291,638.47	C.Y.	.45	131,237.31
4	Scaling					
	a. First 100 C.Y.	100	100	C.Y.	100.00	10,000.00
	b. Over 100 C.Y.	200	352.01	C.Y.	90.00	31,680.90
5	Excavation, Abutment	64,000	95,803.89	C.Y.	4.00	383,215.56
6	Excavation, Foundation	313,000	416,576.48	C.Y.	1.00	416,576.48
7	Excavation, Foundation Trench	59,000	58,973.98	C.Y.	.50	29,486.99
8	Excavation, Cutoff Trench	146,000	259,486.49	C.Y.	1.50	389,229.73
9	Excavation, Dental					
	a. First 100 C.Y.	100	100	C.Y.	100.00	10,000.00
	b. Over 100 C.Y.	200	200	C.Y.	90.00	285,660.00
10	Excavation, Outlet	6,000	8,040.90	C.Y.	10.00	80,409.36
11	Excavation, Spillway	337,000	336,840.24	C.Y.	2.10	707,364.51
12	Excavation, Bypass Channel	160,200	139,637.35	C.Y.	1.50	209,456.03
13	Excavation, Drainage Channel	24,000	23,920.42	C.Y.	1.00	23,920.42

CONTRACT QUANTITIES AND COSTS - CAVE BUTTES DAM

Item No.	Description	Estimated Quantity	Final Quantity	Unit	Unit Price	Total Amount
13-A	Excavation, Outlet Works Channel	60,000	60,028.57	C.Y.	1.80	\$ 108,051.42
14	Excavation, Roads	36,000	35,921.36	C.Y.	2.00	71,842.68
15	Excavation, Toe	22,600	22,471.34	C.Y.	2.00	44,943.68
16	Fill, Outlet Works	3,000	3,064.28	C.Y.	4.00	12,257.14
17	Fill, Roads	134,000	134,026.20	C.Y.	.75	100,519.65
18	Fill, Miscellaneous	131,000	131,000.00	C.Y.	.40	52,400.00
19	Embankment, Dam zone I	289,000	323,926.98	C.Y.	.85	275,368.53
20	Embankment, Dam zone II	1,262,600	1,362,224.64	C.Y.	.75	1,021,668.50
21	Embankment, Dam zone III	975,000	1,003,705.60	C.Y.	1.90	1,907,040.63
22	Embankment, Dikes zone II	710,000	710,107.34	C.Y.	.65	461,569.77
23	Embankment, Dikes zone III	270,000	270,185.56	C.Y.	2.00	540,371.13
24	Additional Rolling	500	497.70	HR.	50.00	24,885.00
25	Filter Material	6,900	6,835.39	C.Y.	4.00	27,341.57
26	Stone, Type I, Dam	32,300	32,143.90	TN.	4.00	128,575.60
27	Stone, Type I, Dikes	39,500	39,349.46	TN.	5.00	196,747.32
28	Riprap, Dam	65,450	65,375.76	TN.	3.00	196,127.27
29	Riprap, Dikes	75,580	75,487.26	TN.	4.00	301,949.06
30	Grouting, Stonework	1,020	1,033.04	C.Y.	30.00	30,992.23

CONTRACT QUANTITIES AND COSTS - CAVE BUTTES DAM

Item No.	Description	Estimated Quantity	Final Quantity	Unit	Unit Price	Total Amount
31	Concrete, Spillway Sill	600	598.62	C.Y.	50.00	\$ 29,931.00
32	Outlet Works	1	1	Job	L.S.	200,000.00
33	Concrete, Dental					
	a. First 100	100	100	C.Y.	150.00	15,000.00
	b. Over 100	50	667.23	C.Y.	130.00	86,739.90
34	Grout, Slurry					
	a. First 100	100	100	C.F.	7.00	700.00
	b. Over 100	100	264	C.F.	6.00	1,584.00
35	Portland Cement	13,450	13,504.14	CWT.	3.00	40,512.43
36	Steel Reinforcement	18,000	18,087.37	LB.	.30	5,426.21
37	Foundation Drilling and Grouting					
	a. Mobilization and Demobilization	1	100%	Job	L.S.	15,000.00
	b. Drilling Exploratory Grout Holes	225	150	L.F.	30.00	4,500.00
	c. Drilling Grout Holes	6,850	9,347	L.F.	7.00	65,429.00
	d. Pipe for Grout Holes	420	763.5	L.F.	10.00	7,635.00
	e. Drill Set-ups	290	344	EA.	30.00	10,320.00
	f. Washing and Pressure Testing	135	143	HR.	85.00	12,155.00

CONTRACT QUANTITIES AND COSTS - CAVE BUTTES DAM

Item No.	Description	Estimated Quantity	Final Quantity	Unit	Unit Price	Total Amount
38	g. Grout Pump Connections	270	378	EA.	20.00	\$ 7,560.00
39	h. Placing Grout	1,755	625.5	Sack	10.00	6,255.00
40	Double Drive Gate	3	3	EA.	1,000.00	3,000.00
41	Corrugated Metal Pipe Arch, 29x18-inch	152	153.10	L.F.	20.00	3,062.00
42	Metal End Sections for 20x18-inch CMP Arch	3	3.02	EA.	85.00	256.08
43	Corrugated Metal Pipe, 36-inch	564	627.24	L.F.	30.00	18,817.26
44	Metal End Section for 36-inch CMP	8	9	EA.	225.00	2,025.00
45	Corrugated Metal Pipe, 54-inch	56	56.37	L.F.	55.00	3,100.24
46	Metal End Section for 54-inch CMP	1	1	EA.	650.00	650.00
47	Reinforced Concrete Pipe, 108-inch	170	161.95	L.F.	250.00	40,488.50
48	Pipe Culvert Inlet and Outlet Structure	4	4	EA.	6,500.00	26,000.00
49	Aggregate Base and Surfacing	7,700	7,697.84	C.Y.	6.00	46,187.03
50	Asphalt Concrete Pavement	3,750	3,751.66	TN.	18.00	67,529.81
51	Traffic Control Devices	1	1	Job	L.S.	3,000.00
52	Guard Rail	110	110.70	L.F.	10.00	1,100.69
53	Water Surface Recording Facility	1	1	Job	L.S.	10,000.00
54	Instrumentation	1	1	Job	L.S.	5,000.00

CONTRACT QUANTITIES AND COSTS - CAVE BUTTES DAM

Item No.	Description	Estimated Quantity	Final Quantity	Unit	Unit Price	Total Amount
53	Overlook Structure and View Point Slab	1	1	Job	L.S.	\$ 43,000.00
54	Overlook Restroom	1	1	Job	L.S.	30,000.00
55	Landscape Fill	19,000	18,954.74	C.Y.	3.50	66,341.58
56	Planting	1	1	Job	L.S.	1,500.00
57	Seeding	28	28	Acre	1,800.00	50,400.00
58	Project Sign	1	1	Job	L.S.	8,000.00
59	Topsoiling	21,000	20,991.58	C.Y.	2.00	41,983.15
					TOTAL	\$9,981,076.36

CONTRACT QUANTITIES AND COSTS - CAVE BUTTES DAM

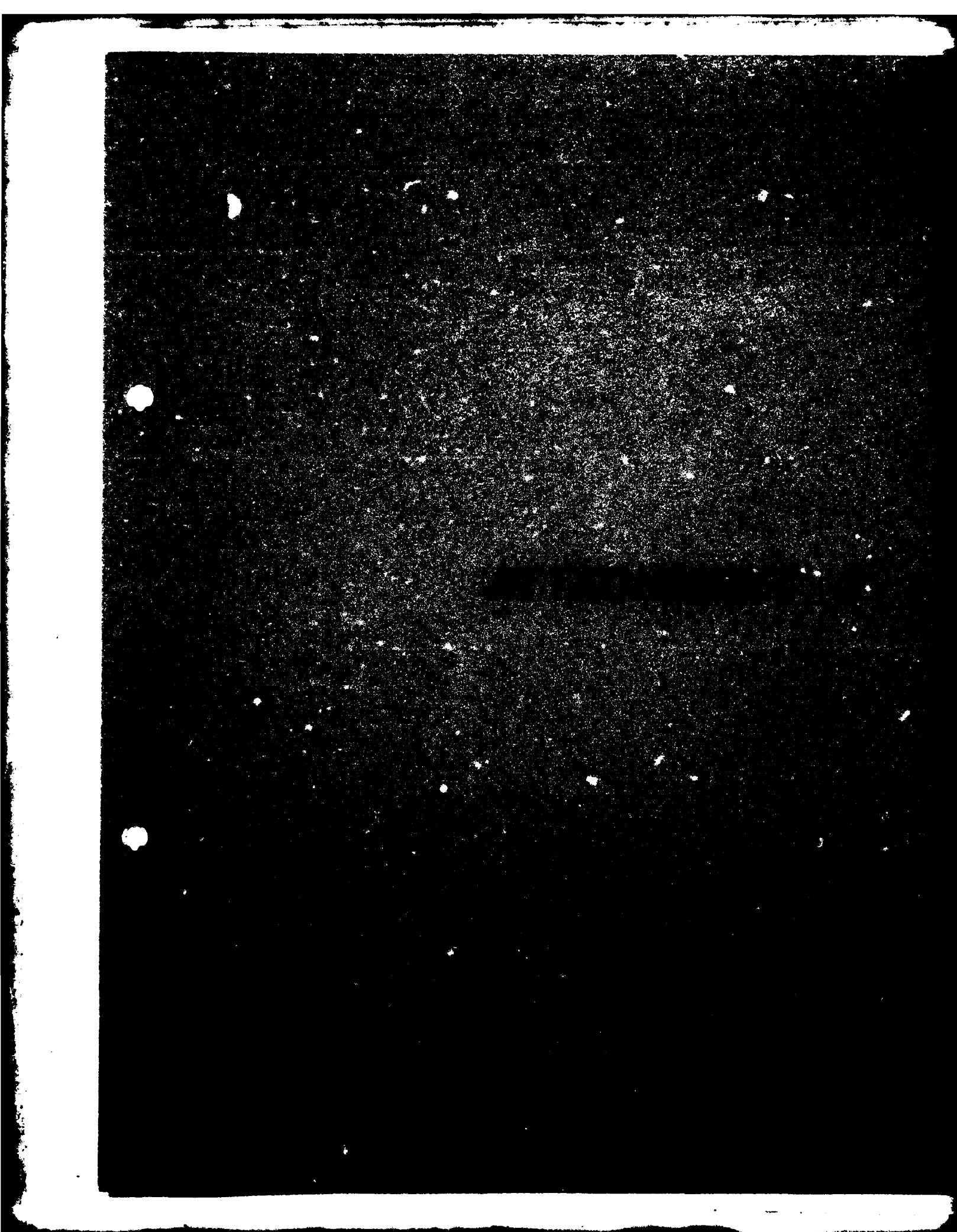
Item No.	Description	Estimated Quantity	Final Quantity	Unit	Unit Price	Total Amount
	<u>MODIFICATIONS</u>					
P00001	Part 2, Modify Outlet Works, dated 08 Aug 1980. No time.		100%	Job		\$ 128,849.00
P00002	Flood Emergency Work, dated 25 Sept 78. Extended to 14 Sept 79.		100%	Job		42,470.00
P00003	Revise Overlook Road, dated 26 Sept 78.		100%	Job		12,087.00
P00004	Revise Scaling, dated 27 Sept 78. No time.		100%	Job		13,885.00
P00005	Temporary Overlook, dated 25 Apr 78. No time.			Job		-0-
P00006	Excavation Disposal and Seeding, dated 18 Aug 78. No time.			Job		-0-
P00007	Modify Cave Creek Road, dated 14 Sept 78. No time.		100%	Job	CR	906.00
P00008	Part 2, Revise Diversion and Control, dated 18 Jul 80. No time.		100%	Job		198,812.00
P00009	Part 2, Revise Cutoff Trench, dated 20 Jul 80. No time.		100%	Job		256,647.00
P000010	Part 2, Repair Abutments, dated 16 Nov 78. No time		100%	Job		1,538,451.00
P000011	Part 2, Excavate Core Material, dated 6 Aug 80. No time.		100%	Job		56,141.00

CONTRACT QUANTITIES AND COSTS - CAVE BUTTES DAM

Item No.	Description	Estimated Quantity	Final Quantity	Unit	Unit Price	Total Amount
P000012	Part 2, Modify Concrete Plug, dated 28 Jul 80. No time.		100%	Job		35,736.00
P000013	Revise Cave Creek Detour, dated 26 Feb 79. No time.		100%	Job		730.00
P000014	Change Measurement of Stone, dated 28 Feb 79. No time.		100%	Job		-0-
P000015	Admin. Change to P00007, dated 8 May 79. No time.		100%	Job		-0-
P000016	Install Barriers on Cave Creek Dam, dated 8 Sept 79. No time.		100%	Job		4,717.00
P000017	Concrete Pad and Canopy, dated 8 May 79. No time.		100%	Job		10,770.00
P000018	Grouted Stone - Outlet Channel, dated 30 Oct 79. No time.		100%	Job		7,381.00
P000019	Office Trailers and Accessories, dated 27 Jul 79. No time.		100%	Job		19,045.00
P000020	Part 2, Impact Claim, dated 17 Sept 80. No time.		100%	Job		2 458,162.00
P000021	Clean-up Borrow Area #4, dated 21 Jul 79. No time.		100%	Job		14,862.00
P000022	Misc. Changes, dated 22 Jul 80. No time		100%	Job		24,685.00
P000023	Prepare and Slot Work, dated 23 Jul 80. No time.		100%	Job		80,644.00

CONTRACT QUANTITIES AND COSTS - CAVE BUTTES DAM

Item No.	Description	Estimated Quantity	Final Quantity	Unit	Unit Price	Total Amount
P000024	Remove ramps, dated 24 Jul 80. No time.		100%	Job		50,169.00
P000025	Modify Overlook Road, dated 25 Jul 80. No time.		100%	Job		21,091.00
P000026	Excess Cost, Dike #2, dated 4 Sept 80. No time.		100%	Job		157,006.00
P000027	Clean-up Borrow Area #1, dated 29 Jul 80. No time.		100%	Job		33,346.00
P000028	Fill zone 3 Pit, dated 30 Jul 80. No time		100%	Job		42,595.00
P000029	Extra Well Costs, dated 29 Jul 80. No time.		100%	Job		50,000.00
P000030	Misc. Work on Overlook Road, dated 1 Aug 80. No time.		100%	Job		24,458.00
P000031	Relocate Office Trailers, dated 4 Aug 80. No time.		100%	Job		19,060.00
P000032	Flood Damage and Quantity Variations, dated 16 Sept 80. No time.		100%	Job		41,969.56
P000033	Backfill Borrow Area #2, dated 1 Oct 80. No time.		100%	Job		60,000.00



DAM FOUNDATION GROUTING SUMMARY

"REMARKS" CODES AND NOTES

REMARKS

1. Hole caving.
2. No pressure test due to excess surface leaks.
3. First stage tight (less than 0.5 GPM take during pressure test), deferred grouting to next stage.
4. No pressure test at stage indicated.
5. Slight water seepage from nearby surface cracks during pressure test.
6. Slight grout leak at surface in area near hole, unless location otherwise stated.
7. Water and grout from nearby surface cracks during grouting.
8. Grouting done through wash rods and then through nipple.
9. Hole tight, filled with thick grout mix by hand.

NOTES

1. Offsets are measured left (upstream) of dam centerline, except where otherwise indicated.
2. Pressures are measured at hole collar (1 to 2 feet above the ground surface).
3. K values are measured to the nearest 0.1 ft./day.
4. Holes 92A through 93D (7 holes) were contact grout holes behind the concrete plug in the outlet conduit.

CAVE BUTTES DAM ARIZONA — FOUNDATION GROUTING SUMMARY

HOLE NO.	HOLE LOCATION		G.S. ELEV. (feet)	INCLINATION (deg.)	BEAR - ING (deg.)	DEPTH	DATE GROUTED	PRESSURE TESTING			GROUTING			REMARKS
	DAM STATION	OFFSET FROM E						FLOW (gpm)	K (ft./day)	PRESS. (psi)	TAKE (bags)	PRESS. (psi)	MIX (w/o)	
51	13+07	26.7L	1592.5	72	S85W	0-40	4/24/78	22.5	.9	40	1-1/4	40	3:1-5:1	3
54	13+17	26.8L	1585.5	70	N80W	0-30	4/25/78	12.3	.6	30	1-1/3	25	5:1	3
53	13+22	27.8L	1582.	77	N68W	0-40	4/24/78	19.2	1.0	30	4-3/4	10	3:1-1.1	5,3
55	13+28	28.4L	1576.5	71	W	0-15	4/25/78	1.7	.4	15	1/4	15	5:1	
52	13+39	25.4L	1565.	80	N76W	0-40	4/24/78	23.0	.9	40	5.0	40	5:1	3
CUTOFF TRENCH														
80A	13+53	29.6L	1552.	78	S11W	0-25	7/17/78	0	0	15	0	20	7.5:1	
80	13+65	26.6L	1554.5	73	S11E	0-30	6/17/78	0	0	15	0	20	7.5:1	
79A	13+78	25.9L	1552.	66	S23E	0-25	6/17/78	0	0	15	0	20	7.5:1	
79	13+97	26.2L	1546.5	72	S76W	0-25	6/14/78	0	0	15	0	15	6:1	
						25-50	6/16/78	0	0	25	0	25	4.4:1	
						50-75	6/17/78	0	0	45	0	50	6:1	
79C	14+03	4.7L	1541.	52	S71E	0-30	4/16/78	0	0	10	2/3	20	4.4:1	
79B	14+09	10.5L	1540.5	62	N87E	0-25	4/16/78	4.8	1.3	5	1-1/4	15	3:1	5. from nearby seep area

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HOLE NO.	HOLE LOCATION		G.S. ELEV. (feet)	INCLINATION (deg.)	BEARING (deg.)	DEPTH	DATE GROUTED	PRESSURE TESTING				GROUTING			REMARKS
	DAM STATION	OFFSET FROM £						FLOW (gpm)	K (ft./day)	PRESS. (psi)	TAKE (bags)	PRESS. (psi)	MIX (w/o)		
77F	14+45	34.3L	1538.	55	N85W	0-15	6/26/78	1.1	.6	5	1-1/4	15	6:1-4:1	5,6 at 77G	
77B	14+49	28.2L	1538.5	60	S70E	0-25	6/17/78	0	0	15	0	15	6:1		
77	14+57	26.5L	1536.5	76	N80W	0-25	6/14/78	0	0	15	0	15	6:1		
						25-50	6/16/78	0	0	25	1/2	30	5:1		
						50-75	6/17/78	0	0	15	1/3	40	3:1-6:1		
76A	14+71	32.4L	1535.	vert	----	0-25	6/15/78	0	0	15	0	25	5:1		
76	14+93	28.4L	1537.	vert	----	0-25	6/14/78	12.1	2.2	10	2-1/3	15	2:1-3:1	5	
						25-50	6/15/78	7.1	.4	35	2	25	4:1-2.5:1		
						50-75	6/16/78	0	0	55	1/4	50	5:1		
75A	15+12	29.3L	1538.5	vert	----	0-25	6/14/78	0	0	15	0	15	5:1-6:1		
75	15+33	30.5L	1540.5	vert	----	0-25	6/14/78	5.3	.7	15	2/3	15	5:1		
						25-50	6/15/78	0	0	35	1/3	30	6:1		
						50-75	6/16/78	0	0	55	1/4	50	5:1		
74A	15+53	33.4L	1544.5	vert	----	0-25	6/14/78	4.9	.7	15	1/3	15	5:1		
74	15+72	33.7L	1544.	vert	----	0-25	6/06/78	0	0	15	1/4	15	6:1		
						25-50	6/08/78	0	0	40	1/4	40	6:1		
						50-75	6/09/78	0	0	55	1/4	50	6:1		

CAVE BUTTES DAM ARIZONA — FOUNDATION GROUTING SUMMARY

HOLE NO.	HOLE LOCATION		G.S. ELEV. (feet)	INCLINATION (deg.)	BEARING (deg.)	DEPTH	DATE GROUTED	PRESSURE TESTING			GROUTING			REMARKS
	DAM STATION	OFFSET FROM E						FLOW (gpm)	K (ft./day)	PRESS. (psi)	TAKE (bags)	PRESS. (psi)	MIX (w/o)	
73C	15+83	34.5L	1542.5	69	N81E	0-15	6/17/78	1.6	.5	10	1-1/3	10	3:1	5,6
													1:1	
73A	15+19	35.1L	1542.	vert	----	0-25	6/06/78	9.9	2.7	5	5-1/2	15	6:1	
													3:1	
73B	16+00	34.0L	1540.	65	S75W	0-15	6/17/78	2.1	.7	10	1/3	15	3:1	
73	16+10	36.7L	1537.5	86	N47W	0-25	6/06/78	9.8	1.4	15	1.2	15	3:1	
						25-50	6/08/78	0	0	40	0	40	6:1	
						50-75	6/19/78	0	0	55	0	50	6:1	
72A	16+28	39.3L	1535.5	vert	----	0-25	6/06/78	5.1	.9	10	2/3	15	6:1	
72C	16+37	37.6L	1535.	62	N65E	0-25	6/12/78	6.8	1.2	10	1	15	1:1	
72	16+46	40.1L	1534.5	vert	----	0-25	6/06/78	10.2	2.8	5	22-1/2	5	1:1	6 from shear
						25-50	6/08/78	5.0	.3	30	2/3	30	2:1	
						50-75	6/12/78	2.4	.1	20	3/4	50	4:1	
													2:1	
													3:1	
72B	16+54	42.4L	1536.5	70	S58W	0-25	6/12/78	0	0	10	1/4	20	6:1	
71A	16+67	41.4L	1535.5	87	S75E	0-25	6/02/78	0	0	15	0	15	5:1	
71	16+87	42.3L	1535.	86	N82W	0-25	6/02/78	0	0	15	1/4	10	5:1	
						25-50	6/06/78	0	0	35	0	25	6:1	
						50-75	6/12/78	0	0	50	0	55	6:1	

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CAVE BUTTES DAM ARIZONA — FOUNDATION GROUTING SUMMARY

HOLE NO.	HOLE LOCATION		G.S. ELEV. (feet)	INCLINATION (deg.)	BEARING (deg.)	DEPTH	DATE GROUTED	PRESSURE TESTING			GROUTING			REMARKS
	DAM STATION	OFFSET FROM CL						FLOW (gpm)	K (ft./day)	PRESS (psi)	TAKE (bags)	PRESS. (psi)	MIX (w/c)	
70A	17+07	39.8L	1535.	vert	----	0-25	6/02/78	5.5	.8	15	1/2	15	5:1	5,8
70	17+27	38.3L	1534.	vert	----	0-25	6/02/78	0	0	15	1/4	15	5:1	
						25-50	6/06/78	12.2	.7	35	1/4	30	6:1	
													3:1	
						50-75	6/12/78	3.3	.1	45	1/3	50	3:1	
69A	17+48	37.5L	1532.5	vert	----	0-25	6/07/78	7.0	1.3	10	1-3/4	15	4:1	5
69	17+67	38.7L	1533.	88	N68E	0-25	6/02/78	13.0	1.8	15	8	10	3:1	5,6
						25-50	6/07/78	0	0	40	1/4	35	1:1	
						50-75	6/12/78	0	0	55	1/4	55	5:1	
													6:1	
68A	17+87	39.5L	1532.	vert	----	0-25	6/02/78	0	0	15	1/4	15	1:1	
													4:1	
68	18+08	39.7L	1530.5	89	S34W	0-25	6/02/78	0	0	15	1/4	15	4:1	
						25-50	6/07/78	4.7	.3	30	1	30	2:1	6
													3:1	
						50-75	6/12/78	4.2	.2	30	1/4	55	3:1	5
													4:1	
67C	18+17	44.6L	1530.	66	S80E	0-20	6/12/78	6.0	1.4	10	3/4	15	6:1	5,6
													3:1	
67A	18+26	40.2L	1529.	82	N60W	0-25	6/07/78	3.5	1.0	5	4-1/4	3	1:1	5,6
						25-50	6/12/78	0	0	25	0	25	6:1	
67B	18+40	33.7L	1529.	67	N60W	0-20	6/12/78	0	0	15	0	15	6:1	

CAVE BUTTES DAM ARIZONA -- FOUNDATION GROUTING SUMMARY

HOLE NO.	HOLE LOCATION		G.S. ELEV. (feet)	INCLINATION (deg.)	BEARING (deg.)	DEPTH	DATE GROUTED	PRESSURE TESTING			GROUTING			REMARKS
	DAM STATION	OFFSET FROM C						FLOW (gpm)	K (ft./day)	PRESS. (psi)	TAKE (bags)	PRESS. (psi)	MIX (w/c)	
67	18+46	39.4L	1530.	87	S70W	0-25	6/02/78	0	0	15	1.0	15	4:1	
						25-50	6/07/78	0	0	40	1/3	40	5:1	
						50-75	6/12/78	0	0	55	1/4	55	6:1	
66A	18+68	39.6L	1530.5	vert	----	0-25	6/02/78	5.4	.8	15	1-1/4	15	5:1-3:1	5,6 from nearby shear
66	18+86	39.4L	1530.5	vert	----	0-25	5/09/78	5.6	.6	20	1-1/4	20	2.5:1-1:1	6
						25-50	5/12/78	15.2	.8	35	2-3/4	50	5:1	6
						50-75	5/16/78	9.8	.3	60	1/2	25	5:1-2:1	6
65A	19+06	39.6L	1530.5	vert	----	0-25	5/16/78	0	0	15	1/3	15	5:1	
65	19+25	40.6L	1530.5	88	S13E	0-25	5/09/78	3.4	.3	25	1/2	25	5:1	
						25-50	5/12/78	0	0	40	1/4	50	5:1	
						50-75	5/16/78	0	0	60	1/4	55	5:1	
64A	19+49	39.4L	1530.5	87	S47E	0-25	5/16/78	6.6	1.2	10	1	25	5:1-2:1	6
64	19+65	38.5L	1530.0	87	S67W	0-25	5/09/78	6.1	.8	15	1/2	25	2:1	6
						25-50	5/12/78	0	0	35	1/4	35	2:1-4:1	
						50-75	5/16/78	0	0	55	3/4	60	2:1-5.5:1	
63A	19+86	39.9L	1530.	vert	----	0-25	5/19/78	4.2	.6	15	1/2	25	4.5:1	6

CAVE BUTTES DAM ARIZONA — FOUNDATION GROUTING SUMMARY

HOLE NO.	HOLE LOCATION		G.S. ELEV. (feet)	INCLINATION (deg.)	BEARING (deg.)	DEPTH	DATE GROUTED	PRESSURE TESTING			GROUTING			REMARKS
	DAM STATION	OFFSET FROM E						FLOW (gpm)	K (ft./day)	PRESS. (psi)	TAKE (bags)	PRESS. (psi)	MIX (w/o)	
63	20+05	42.0L	1529.5	vert	----	0-25	5/09/78	0	0	25	2-3/4	20	5:1-1:1	6
						25-50	5/12/78	3.3	.3	20	1-1/3	40	1:1-2:1	6
						50-75	5/19/78	0	0	50	1/4	35	4.5:1	
62A	20+25	42.5L	1530.5	88	N70W	0-25	5/19/78	0	0	20	1/2	20	4.5:1	
62B	20+36	36.7L	1532.5	66	N60W	0-30	5/24/78	0	0	25	0	20	4:1	
62	20+44	42.3L	1530.5	vert	----	0-25	5/09/78	0	0	25	0	25	5:1	
						25-50	5/12/78	0	0	40	1/4	50	4.5:1	
						50-75	5/19/78	1.8	.1	50	3/4	50	1:1-3:1	
62C	20+49	41.9L	1532.	55	S47E	0-20	5/24/78	0	0	15	2	15	4:1	6
						20-40	5/26/78	0	0	15	1/4	10	2:1-3:1	
62E	20+53	44.6L	1533.	64	N65E	0-30	5/26/78	0	0	10	1/3	10	3:1	
62F	20+53	28.0L	1529.5	57	N42E	0-35	5/26/78	0	0	10	1/4	10	1.5:1-2:1	
62D	20+59	43.2L	1531.5	87	S27E	0-30	5/24/78	6	.7	15	1/4	15	1.5:1	5
61A	10+66	43.7L	1529.	vert	----	0-25	5/19/78	17.5	2.4	15	8-1/4	5	2:1-1:1	6
						25-35	5/24/78	5.6	1.2	15	3	5	2:1	6 at 61C

CAVE BUTTES DAM ARIZONA — FOUNDATION GROUTING SUMMARY

HOLE NO.	HOLE LOCATION		G.S. ELEV. (feet)	INCLINATION (deg.)	BEARING (deg.)	DEPTH	DATE GROUTED	PRESSURE TESTING			GROUTING			REMARKS
	DAM STATION	OFFSET FROM E						FLOW (gpm)	K (ft./day)	PRESS. (psi)	TAKE (bags)	PRESS. (psi)	MIX (w/o)	
61C	20+67	40.4	1529.	81	S64E	0-25	5/23/78	10.2	1.4	15	2-1/3	10	1:1	6 at 61A
61D	20+73	29.7L	1529.5	63	N77W	0-25	5/26/78	6.0	.8	15	1-3/4	5	1.5:1	6 at 61A
61B	20+79	45.3L	1531.5	76	N88W	0-35	5/24/78	4.1	.5	10	1/4	15	1.5:1	5
61	20+84	45.0L	1531.	vert	----	0-25	5/05/78	1.8	.2	25	3-3/4	20	8:1-1.5:1	8,6
						25-40	5/11/78	--	--	30	3/4	35	2:1-5:1	6
						40-75	5/16/78	6.0	.2	35	1	50	5:1	
60A	21+05	42.5L	1531.5	vert	----	0-25	5/16/78	0	0	15	0	15	5:1	
60	21+24	45.7L	1530.5	vert	----	0-25	5/05/78	0	0	25	0	25	5:1	
						25-50	5/11/78	9.6	.4	60	1	10	4:1-1.5:1	
						50-75	5/16/78	0	0	25	1/2	50	3:1-5:1	
59C	21+39	46.3L	1529.5	65	S67E	0-30	5/23/78	0	0	25	1-3/4	25	5:1-2:1	8
59A	21+45	44.4L	1529.5	vert	----	0-25	5/16/78	.6	.2	5	1-3/4	15	1.6:1	8,6
59E	21+50	30.3L	1529.5	63	N11W	0-25	5/26/78	0	0	10	1/4	10	1.4:1-3:1	
59F	21+51	27.2L	1529.	63	N76E	0-30	5/26/78	2.7	.4	10	1/2	10	3:1	

CAVE BUTTES DAM ARIZONA — FOUNDATION GROUTING SUMMARY

HOLE NO.	HOLE LOCATION		G.S. ELEV. (feet)	INCLINATION (deg.)	BEARING (deg.)	DEPTH	DATE GROUTED	PRESSURE TESTING			GROUTING			REMARKS
	DAM STATION	OFFSET FROM C						FLOW (gpm)	K (ft./day)	PRESS. (psi)	TAKE (bags)	PRESS. (psi)	MIX (w/e)	
59B	21+54	40.3L	1520.4	vert	----	0-25	5/23/78	2.7	.5	10	1-1/4	20	2:1-3.4:1	5,8,6
59	21+66	43.4L	1529.5	vert	----	0-20	5/05/78	0	0	25	2-1/4	25	5:1-1:1	8
						20-50	5/11/78	5.0	.4	15	2-1/2	5	4:1-1.5:1	8
						50-75	5/16/78	0	0	30	2-1/2	30	1:1-3:1	
59G	21+70	35.3L	1529.	59	S77W	0-30	5/26/78	4.6	.7	10	3	10	3:1-1.8:1	
59D	21+70	38.9L	1529.	55	N54W	0-35	5/23/78	0	0	25	2-1/4	25	5:1-2:1	8
59H	21+82	46.4L	1529.5	66	N71E	0-35	5/26/78	0	0	10	1/4	10	3:1	
58	21+85	43.9L	1530.	vert	----	0-25	5/05/78	0	0	25	1/3	15	4.5:1	
						25-50	5/11/78	2.5	.1	40	1/4	35	2:1	
						50-75	5/19/78	3.6	.2	20	1	20	2:1	
58G	21+87	16.6L	1528.5	60	N73E	0-30	5/30/78	4.6	.7	10	1-3/4	10	2:1	
58B	21+89	46.0L	1529.5	73	S70E	0-25	5/23/78	1.0	.2	10	3	5	5:1-1.1	5,6
58F	21+94	2.0L	1529.5	54	N	0-35	5/30/78	0	0	10	1/2	15	3:1	

CAVE BUTTES DAM ARIZONA -- FOUNDATION GROUTING SUMMARY

HOLE NO.	HOLE LOCATION		G.S. ELEV. (feet)	INCLINATION (deg.)	BEARING (deg.)	DEPTH	DATE GROUTED	PRESSURE TESTING				GROUTING			REMARKS
	DAM STATION	OFFSET FROM E						FLOW (gpm)	K (ft./day)	PRESS. (psi)	TAKE (bags)	PRESS. (psi)	MIX (w/a)		
58C	22+01	17.7L	1529.	68	N67W	0-10	5/23/78	--	--	--	5-1/4	5	1:1-5:1	6	
						10-30	5/26/78	9.6	1.7	10	19	5	2:1-1:1		
58D	22+01	39.7L	1530.5	76	N57W	0-30	5/23/78	9.0	1.3	10	1	25	1:1-2:1		
58E	22+02	33.4L	1530.	64	S23W	0-30	5/30/78	3.5	.5	10	9-1/3	15	1:1		
58	22+04	43.9L	1530.	vert	----	0-25	5/05/78	0	0	25	1/3	15	4.5:1		
						25-50	5/11/78	2.5	.1	40	1/4	35	2:1		
						50-75	5/19/78	3.6	.2	20	1	20	2:1		
57B	22+23	38.7L	1530.	vert	----	0-25	5/23/78	0	0	15	1/4	20	5:1		
57A	22+25	43.3L	1529.	vert	----	0-25	5/19/78	0	0	20	2/3	20	5:1		
57D	22+37	39.9L	1529.	vert	----	0-25	5/25/78	4.0	1.1	5	3	5	2:1-1:1		
						25-50	5/30/78	1.3	.1	10	1/4	15	2:1	8	
57	22+43	41.4L	1527.5	vert	----	0-15	5/05/78	10.0	5.2	5	2-2/3	15	1.5:1	5	
						15-50	5/11/78	0	0	35	4-3/4	40	3:1-1.5:1		
						50-75	5/19/78	2.9	.2	15	3	5	2.5:1-1:1		
57C	22+50	35.3L	1529.	vert	----	0-25	5/25/78	0	0	10	2	15	2:1	8	
						25-50	5/30/78	3.6	.4	10	3/4	15	2:1		

CAVE BUTTES DAM ARIZONA — FOUNDATION GROUTING SUMMARY

HOLE NO.	HOLE LOCATION		G.S. ELEV. (feet)	INCLINATION (deg.)	BEARING (deg.)	DEPTH	DATE GROUTED	PRESSURE TESTING			GROUTING			REMARKS
	DAM STATION	OFFSET FROM §						FLOW (gpm)	K (ft./day)	PRESS. (psi)	TAKE (bags)	PRESS. (psi)	MIX (w/o)	
56A	22+62	35.4L	1528.5	vert	----	0-25	5/19/78	0	0	15	0	20	5:1	
56	22+83	43.4L	1528	vert	----	0-25	5/05/78	0	0	25	1-2/3	25	5:1	
						25-50	5/11/78	3.6	.4	10	3/4	35	5:1	8
						50-75	5/19/78	0	0	10	2-3/4	5	2.5:1	
81R	23+01	40.9L	1528.	vert	----	0-25	6/27/78	13	2.4	10	1	15	2:1	6 at shear
81D	23+12	41.3L	1529.	69	S72E	0-25	7/07/78	0	0	15	1/3	15	6:1	
81	23+21	41.9L	1529.	74	N26W	0-25	6/28/78	1.8	.5	5	16-1/3	5	4:1-1:1	5, 6
						25-50	6/30/78	11.0	.9	20	1/2	30	1:1	5
						50-75	7/11/78	0	0	45	0	55	6:1	
81C	23+21	42.8L	1529.	81	S52W	0-25	7/07/78	3.6	.5	15	2-3/4	15	2:1	5, 6 and 7 at 81D
81A	23+41	40.7L	1529.	vert	----	0-25	6/28/78	4.0	.6	15	1/3	20	4:1	
82	23+61	39.7L	1528.5	87	N63W	0-25	6/28/78	0	0	15	0	15	5:1	
						25-50	6/30/78	0	0	30	0	35	6:1	
						50-75	7/11/78	0	0	55	0	55	6.5:1	
82C	23+73	38.4L	1527.	76	N49E	0-25	7/07/78	0	0	15	0	15	6:1	
82A	23+82	42.2L	1526.	83	S	0-25	6/27/78	4.4	.8	10	14-1/2	10	2:1-1:1	6 and at nearby shears

CAVE BUTTES DAM ARIZONA — FOUNDATION GROUTING SUMMARY

HOLE NO.	HOLE LOCATION		G.S. ELEV. (feet)	INCLINATION (deg.)	BEARING (deg.)	DEPTH	PRESSURE TESTING				GROUTING			REMARKS
	DAM STATION	OFFSET FROM E					DATE GROUTED	FLOW (gpm)	K (ft./day)	PRESS. (psi)	TAKE (bags)	PRESS. (psi)	MIX (w/a)	
82B	23+87	53.5L	1528.	59	S6E	0-25	7/07/78	2.0	.3	15	1-1/2	15	3:1	5,6
83	24+02	37.9L	1526.	76	S20E	0-25	6/27/78	4.4	.6	15	0	15	2:1	
						25-50	6/30/78	4.3	.3	20	1	25	3:1	5,6 at shear
						50-75	7/11/78	0	0	45	1/4	55	2:1	4ft. SE
83A	24+21	37.0L	1528.	VERT	----	0-25	6/28/78	.5	.1	15	0	15	5:1	
84	24+41	39.3L	1528.	75	N5E	0-25	6/28/78	0	0	15	1/3	15	5:1	6
						25-50	6/30/78	8.5	.5	30	1/2	30	3:1	5,6
						50-75	7/11/78	1.6	.1	35	1/3	40	6.5:1	
84C	24+54	35.1L	1528.5	68	S42E	0-25	7/07/78	9.6	2.5	15	1/4	15	6:1	
84A	24+62	38.2L	1529.	79	S28E	0-25	6/27/78	2.8	.8	5	7	15	2:1	5,6 at nearby shear
84B	24+70	39.0L	1529.	66	S7E	0-25	7/07/78	9.6	2.6	5	10	10	3:1	5,6
85	24+82	37.6L	1527.5	74	S28E	0-25	6/29/78	0	0	15	1/4	15	5:1	5,6 at 85A
						25-50	7/06/78	7.2	.4	35	1/4	35	5.5:1	5,6
						50-75	7/12/78	3.5	.3	10	1/2	40	4:1	
85A	24+99	39.7L	1526.	64	S33E	0-25	6/29/78	4.5	1.2	5	1-3/4	15	1:1	5,6
86	25+23	43.1L	1526	73	S6E	0-25	7/06/78	2.4	.2	15	1/3	15	5.5:1	5,6
						25-50	7/06/78	2.4	.2	15	1-3/4	25	5.5:1	5,6 and shears 2 to 4ft. away

CAVE BUTTES DAM ARIZONA — FOUNDATION GROUTING SUMMARY

HOLE NO.	HOLE LOCATION		G.S. ELEV. (feet)	INCLINATION (deg.)	BEARING (deg.)	DEPTH	DATE GROUTED	PRESSURE TESTING			GROUTING			REMARKS
	DAM STATION	OFFSET FROM E						FLOW (gpm)	K (ft./day)	PRESS. (psi)	TAKE (bags)	PRESS. (psi)	MIX (w/o)	
90A	26+97	38.3L	1526.5	56	S53W	0-25	7/12/78	0	0	15	1/3	15	5.5:1	
78B	27+12	41.5L	1527.5	56	S81E	0-30	8/04/78	5.5	1.2	5	2/3	15	4:1	
						30-40	8/07/78	1.1	.1	35	0	30	6:1	
98	27+14	36.7L	1526.5	64	S25E	0-25	7/29/78	0	0	15	1/4	15	6.5:1	
						25-50	8/01/78	4.3	.2	40	1/4	40	5:1	
						50-75	8/04/78	3.3	.2	25	3/4	45	5:1	
98C	27+15	26.0L	1527.	56	S82E	0-30	8/04/78	7.5	1.1	10	1-1/3	15	3.5:1-2.5:1	5
						30-40	8/07/78	1.6	.2	30	1/4	30	5:1	
98A	27+34	41.7L	1524.	87	S77E	0-25	7/29/78	0	0	15	0	20	6.5:1	
97C	27+45	47.5L	1534.5	64	S68W	0-20	8/02/78	4.4	1	10	2/3	20	6:1-3:1	5 on rock face below
						20-40	8/04/78	6.2	.9	10	1-1/3	20	6:1-3:1	
97E	27+45	36.0	1532.5	60	S5W	0-15	8/09/78	4.0	1.3	10	1	10	4:1	5-8' SSW at base of cut slope
97F	27+49	30.8L	1534.	66	S41W	0-17	8/09/78	0	0	10	2/3	15	5.5:1-4:1	
97B	27+50	40.7L	1534.5	59	S13W	0-40	8/02/78	9.1	.7	15	1-1/3	15	3:1	3, 6 at 98A

CAVE BUTTES DAM ARIZONA — FOUNDATION GROUTING SUMMARY

HOLE NO.	HOLE LOCATION		G.S. ELEV. (feet)	INCLINATION (deg.)	BEARING (deg.)	DEPTH	DATE GROUTED	PRESSURE TESTING			GROUTING			REMARKS
	DAM STATION	OFFSET FROM E						FLOW (gpm)	K (ft./day)	PRESS. (psi)	TAKE (secs)	PRESS. (psi)	MIX (w/c)	
97B	(CONTINUED)					40-60	8/04/78	5.5	.5	15	1	35	5:1	
97D	27+52	16.5L	1530	48	N57W	0-15	8/02/78	---	---	---	1/2	15	2:1	2,5,6
						15-27	8/04/78	---	---	---	2	10	5:1	2,5,6
						0-20	8/07/78	6.7	2.4	5	1	10	3:1	
													5.3:1	re-drill and
													3.5:1	re-grout
97	27+53	38.5L	1535.	59	S66E	0-25	7/29/78	2.7	.4	15	1/4	15	6.5:1	
						25-50	8/01/78	6.5	.6	15	1/2	40	5.5:1	5
						50-75	8/02/78	7.0	.4	20	3/4	45	5:1	
													3.5:1	
97A	27+72	36.0L	1535.	57	S40E	0-25	7/29/78	4.9	.5	20	1/3	15	6.5:1	
96	27+90	34.1L	1529.5	62	S31E	0-25	7/29/78	6.8	.8	20	1/4	15	6.5:1	
						25-50	8/01/78	4.7	.4	15	1/4	40	5.5:1	
						50-75	8/07/78	6.7	.3	45	3/4	45	5.5:1	
96B	27+94	50.2L	1526.5	55	S80E	0-30	8/07/78	1.2	.1	15	1/2	15	6:1	
96A	28+1-	31.3L	1527.	66	S41E	0-25	8/01/78	1.9	.4	10	1/4	20	5:1	
95F	28+19	61.6L	1526.5	64	S47E	0-25	8/07/78	4.3	.6	15	1	10	6:1	5
													5:1	
95C	28+19	44.0L	1526.	54	N45W	0-25	8/09/78	5.6	1.5	5	4-3/4	10	5:1	
													2:1	
95E	28+20	50.7L	1525.	51	S80W	0-30	8/07/78	3.0	.4	10	1/3	15	6:1	

CAVE BUTTES DAM ARIZONA — FOUNDATION GROUTING SUMMARY

HOLE NO.	HOLE LOCATION		G.S. ELEV. (feet)	INCLINATION (deg.)	BEARING (deg.)	DEPTH	DATE GROUTED	PRESSURE TESTING			GROUTING			REMARKS
	DAM STATION	OFFSET FROM C						FLOW (gpm)	K ft./day	PRESS. (psi)	TAKE (bags)	PRESS. (psi)	MIX (w/c)	
95D	28+27	61.6L	1525.5	59	N56E	0-20	8/07/78	1.3	.3	10	2-3/4	10	6:1-4:1	6 at seep 4ft east
95H	28+29	64.3L	1525.	60	S54E	0-15	8/09/78	4.3	2.2	5	1/4	15	3:1	5, 6 at 95I
95	28+29	32.2L	1529.	66	S33E	0-25	8/01/78	2.5	.3	15	1/2	20	5:1	
						25-50	8/02/78	2.5	.4	25	1	25	5:1	
						50-75	8/04/78	1.9	.1	45	1-1/4	45	6:1	
95C	28+32	58.5L	1526.5	61	N38E	0-20	8/07/78	5.7	2.0	5	1/4	15	6:1	
95I	28+34	62.7L	1534.	73	S33E	0-15	8/09/78	2.6	.8	10	2-1/4	10	3:1	5, 6
95J	28+42	44.0L	1527.	59	N38W	0-15	8/09/78	5.4	1.7	10	3-1/4	5	6:1-1.6:1	5, 6
95B	28+45	63.6L	1530.5	53	S26E	0-15	8/07/78	2.2	.7	10	1/2	15	6:1	5
95A	28+49	31.9L	1530.	68	S48E	0-25	7/29/78	4.9	.7	15	1/4	20	6:1	
94D	28+67	63.3L	1525.5	48	S28E	0-15	8/07/78	2.5	.9	8	3-1/3	5	6:1-3:1	5, 6
94C	28+68	34.7L	1530.	61	S32E	0-25	8/04/78	0	0	15	0	15	7:1	
						25-50	8/07/78	6.4	.4	30	1	30	6:1	6 near 94D
						50-75	8/08/78	15.9	.6	50	3	40	6:1-4:1	
94	28+74	28.0L	1534.	65	S51E	0-25	7/28/78	0	0	15	0	15	7:1	

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CAVE BUTTES DAM ARIZONA — FOUNDATION GROUTING SUMMARY

HOLE NO.	HOLE LOCATION		G.S. ELEV. (feet)	INCLINATION (deg.)	BEARING (deg.)	DEPTH	DATE GROUTED	PRESSURE TESTING			GROUTING			REMARKS
	DAM STATION	OFFSET FROM E						FLOW (gpm)	K (ft./day)	PRESS. (psi)	TAKE (bags)	PRESS. (psi)	MIX (w/o)	
93	29+10	29.3L	1556.5	81	S18E	0-30	7/26/78	7.3	.7	20	3/4	40	6.5:1	
						30-60	7/27/78	3.3	.1	40	1-1/4	20	7.5:1-	
													6:1	
92	29+31	29.1L	1564.3	79	S76E	0-20	7/20/78	2.1	.4	15	0	20	7.5:1	
						20-40	7/24/78	2.1	.2	20	0	35	6:1	
91A	29+47	26.8L	1574.	74	S20E	0-20	7/20/78	0	0	15	0	15	7.5:1	
						20-40	7/24/78	1.0	.1	25	1/4	30	8:1	
91	29+63	27.1L	1578.5	69	S22E	0-25	7/24/78	0	0	15	0	20	7.5:1	
35	29+81	25.3L	1583.	70	N47E	0-40	7/23/78	0	0	40	1/4	40	6:1	3
34	30+09	23.4L	1591.	69	S79E	0-40	7/23/78	7.5	.3	40	1	40	6:1	3
33	30+29	14.7L	1594.	80	S73E	0-40	7/22/78	2.9	.1	40	1/4	40	6:1	3
32	30+19	20.5L	1592.	72	S68E	0-15	2/15/78	14.5	7.4	5	23	10	5:1-	
													2:1	
						15-40	2/21/78	17.2	.9	40	7-1/3	40	5:1-	
													3:1	
31	30+54	13.2L	1605.5	70	N78E	0-40	2/15/78	12.7	.5	40	3/4	40	5:1	3
30	30+91	13.0L	1618.5	75	S65E	0-40	2/15/78	5.0	.2	40	4-1/4	40	5:1	

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CAVE BUTTES DAM ARIZONA — FOUNDATION GROUTING SUMMARY

HOLE NO.	HOLE LOCATION		G.S. ELEV (feet)	INCLINATION (deg.)	BEAR-ING (deg.)	DEPTH	DATE GROUTED	PRESSURE TESTING			GROUTING			REMARKS
	DAM STATION	OFFSET FROM C						FLOW (gpm)	K (ft./day)	PRESS. (psi)	TAKE (bags)	PRESS. (psi)	MIX (w/a)	
29	31+27	5.2L	1631	78	E	0-20 20-40	2/15/78 2/21/78	5.0 0	.7 0	20 40	1/3 1/3	20 35	5:1 5:1	
28	31+65	5.5L	1644.5	74	N70E	0-20	2/15/78	18.1	2.5	20	2-1/3	20	5:1	
27	32+04	1.6L	1655.5	71	S45E	0-40	2/21/78	16.4	.6	40	2-2/3	40	5:1	3
		DIKE NO. 1												
26	32+40	2.0L	1670.	71	N75E	0-40	2/21/78	4.2	.2	40	1/4	40	5:1	3
23	34+03	0.6R	1670.	87	N48W	0-10 10-25	2/08/78 2/09/78	----- 0	--- 0	-- 25	1 1/4	5 --	2:1 5:1	2
22	34+03	4	1662.5	87	S58E	0-25	2/08/78	0	0	25	0	--	5:1	9
21	34+43	2.1L	1657.5	vert	----	0-25	2/08/78	0	0	25	0	--	5:1	9
20	34+83	0.2L	1654.5	85	S48W	0-25	2/09/78	9.1	.8	25	1/2	25	5:1	
19	35+25	1.0L	1653.5	vert	----	0-25	2/09/78	8.0	1.1	15	3/4	25	2:1- 5:1	5
18	35+66	0.2L	1655.	87	N48E	0-25	2/09/78	7.1	.8	20	1/4	25	5:1	
17	36+06	0.3L	1653.5	vert	----	0-25	2/08/78	8.7	1.2	15	1/2	25	5:1	
16	36+46	1.2L	1648.5	vert	----	0-25	2/08/78	2.9	.4	15	1/2	25	5:1	
15	36+85	1.5L	1642.5	vert	----	0-10 10-25	2/02/78 2/06/78	--- ---	--- ---	--- ---	1/2 1/4	5 25	5:1 5:1	5,6

CAVE BUTTES DAM ARIZONA -- FOUNDATION GROUTING SUMMARY

HOLE NO.	HOLE LOCATION		G.S. ELEV. (feet)	INCLINATION (deg.)	BEARING (deg.)	DEPTH	DATE GROUTED	PRESSURE TESTING			GROUTING			REMARKS
	DAM STATION	OFFSET FROM E						FLOW (gpm)	K (ft./day)	PRESS. (psi)	TAKE (bags)	PRESS. (psi)	MIX (w/o)	
14	37+25	0.4L	1636.5	vert	----	0-10	2/02/78	--	---	---	1/2	5	5:1	5,6
						10-25	2/06/78	--	---	---	1	25	5:1	
													1.5:1	
13	37+64	0.6R	1633.5	vert	----	0-10	2/02/78	--	---	---	0	25	5:1	5
12	38+04	0.3R	1637.	vert	----	0-25	2/08/78	0	0	25	0	25	3:1	9
11	38+44	2.7L	1639.	89	N35E	0-10	1/31/78	3.4	1.6	10	2	5	1:1	5,6
10	38+83	1.9L	1644.5	89	N54W	0-10	1/31/78	8.8	4.2	10	1	10	1:1	5,6
													5:1	
9	39+23	1.3L	1649.5	88	N55E	0-10	1/31/78	.2	1	10	0	5	1:1	1
						10-25	2/03/78	--	---	---	1/2	25	5:1	
8	39+62	4L	1653.	87	S75E	0-10	1/31/78	1.9	.9	10	1/2	10	1:1	
						10-25	2/03/78	--	---	---	0	25	5:1	
7	40+02	2.6R	1654.	86	N85E	0-10	1/31/78	6.0	4.9	5	1/2	5	5:1	
													3:1	
						10-14	2/01/78	--	---	---	1	15	2.5:1	5,6
						14-25	2/03/78	--	---	---	1-1/2	25	5:1	
6	40+41	0.7R	1657.5	vert	----	0-10	1/31/78	7.0	.1	10	0	10	5:1	
						10-25	1/31/78	--	---	---	1/3	25	5:1	
5	40+81	2.4R	1658.	86	N41E	0-4	1/31/78	--	---	---	0	10	5:1	
							2/02/78	.6	.1	8	0	25	5:1	

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CAVE BUTTES DAM ARIZONA -- FOUNDATION GROUTING SUMMARY

HOLE NO.	HOLE LOCATION		G.S. ELEV. (feet)	INCLINATION (deg.)	BEARING (deg.)	DEPTH	DATE GROUTED	PRESSURE TESTING				GROUTING			REMARKS
	DAM STATION	OFFSET FROM E						FLOW (gpm)	K (ft./day)	PRESS. (psi)	TAKE (bags)	PRESS. (psi)	MIX (w/o)		
4	41+21	2.4R	1658.	87	S85E	0-4	1/31/78	--	---	---	0	10	5:1		
						4-25	2/02/78	.7	.2	8	1/3	25	5:1		
3	41+62	2.4R	1658.5	vert	----	0-10	1/31/78	5.5	4.4	5	1-1/2	5	3.5:1	8	
						10-25	2/03/78	---	---	---	1-1/2	25	5:1-		
													2.5:1		
25	42+90	0.5R	1662.	vert	----	0-10	2/03/78	---	---	---	----	10	5:1		
2	42+01	1.4R	1663.	87	S22E	0-10	1/31/78	---	---	---	1/3	10	5:1		
						10-25	2/01/78	0	0	30	6-1/3	25	5:1-		
													3:1-		
24	42+10	0.9R	1666.5	vert	----	0-4	2/02/78	---	---	---	1-2/3	5	1:1	6	
						4-10	2/03/78	---	---	---	1/3	10	5:1		
1	42+40	0.8R	1670.	87	S22E	0-25	1/26/78	0	0	30	0	30	3:1	9	
36	51+01	4.2R	1657.5	81	N54W	0-25	2/28/78	0	0	25	1/4	25	6:1		
37	51+40	1.6L	1652.	80	N85W	0-25	2/28/78	5.8	.5	25	1/4	25	8:1		
38	51+79	0.3L	1646.5	83	N69W	0-25	2/28/78	1.6	.2	25	1/2	25	6:1		
39	52+19	1.8L	1640.5	80	N82W	0-25	2/28/78	2.8	.3	25	1.2	25	6:1		
40	52+58	0.8R	1634.5	83	W	0-25	2/28/78	8.9	.8	25	2	25	6:1		

